

Medical Extracts

VOL-1

1799



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TO

THE RIGHT HONOURABLE

SIR JOSEPH BANKS, BARONET, K. B.

PRESIDENT OF THE ROYAL SOCIETY, &c. &c. &c.

SIR,

AS patron of the liberal sciences, and more especially from the native benevolence of your disposition, as the favourer of every attempt that may tend to confirm the health, and remove the afflictions of mankind, this Work is humbly presented to your notice.

It is presumed, that it will be found amusing to the philosopher, who considers the human frame as a part, and certainly not the least interesting part, of natural history.

It places man in the centre, and shews his relationship to the several objects which surround him.

IN the FIRST VOLUME, is displayed the progress of medicine and chemistry; and the relationship we stand in to the air we breathe.

THE SECOND VOLUME discloses our relationship to light, heat, food, exercise, and all the variety of mental emotion.

These *two volumes* include the history of *direct stimuli**, being an explanation of the First Law of the Animal Œconomy, “*that health is maintained by a due proportion of stimuli,*” with the history of *those diseases arising from the superabundance of natural stimuli*, and the proper method of cure.

THE THIRD VOLUME embraces the consideration of *indirect stimuli**, as impure air, darkness, cold, hunger, rest, and the different sedative passions of the mind, which are no otherways stimuli than as they relate to the Second Law, “*that an accumulation of irritability ensues from a deficiency of direct stimuli;*” and this Volume embraces the diseases of *asthenia*, or weakness.

* Vide the Definition of this term, page 257.

- The FOURTH VOLUME is employed in the consideration of the Third Law, “ *that the excessive action of stimuli exhausts the irritable principle in the blood;*” and here the action of *different poisons* is fully considered, with the *methodus medendi*, or *antidote*.

The FIFTH VOLUME is a continuation of the *same subject*, shewing more particularly the rise and progress of *Pneumatic Medicine*.

Thus have we attempted to set forth the Brunonian System, as improved by the latest discoveries in chemistry and medicine; and, perhaps, we shall be said to have aimed at the establishment of a *New System* of physiology and medicine, which hath arisen out of the old, like the phoenix from the ashes of its parent, carrying on its wings the means of preserving health, and warding off disease; a system not to be considered in itself as perfect, but only as the foundation of a better structure, which future industry may erect, and which may not moulder, like other fabricks, into the sand of which they were composed, but as being founded upon *facts*, and *reasonings drawn from them*, may stand

stand unimpaired, like the Newtonian Philosophy, a rock amidst the waste of ages.

Wishing you, Sir, the enjoyment of a long life, devoted even from the earliest period to the service of your country, and the cause of science.

I have the honour to subscribe myself,

SIR,

With the greatest respect and esteem,

Your faithful, obliged,

And obedient Servant,

Æc. Æc.

LONDON,
May 1, 1790.

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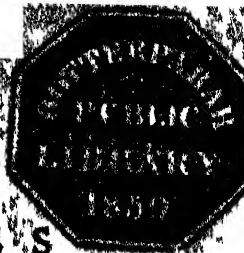
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THE
PROGRESS
OF
MEDICINE

Viresque acquirit eundo.

Vine

SECTION I.

Hippocrates, who is supposed to have lived 400 years before the birth of Christ, is the most ancient author whose writings expressly on the subject of the medical art are preserved, and he is therefore justly considered as the father of physic. All the accounts which we have prior to this time, if not evidently fabulous, are at the utmost highly conjectural. Even the medical knowledge of Pythagoras, so much celebrated as a philosopher, can hardly be considered as resting on any other foundation. But from the times of Hippocrates, medicine separated from philosophy and religion, seems to have assumed the form of a science, and to have been pursued as a profession. It may not, therefore, be improper to

to give a particular account of the state of medical knowledge as transmitted to us in his writings. The writings attributed to Hippocrates, it may be remarked, are not probably all his. Nor is it wonderful that attempts should have been made to increase the value of manuscripts, by attributing them to a name of such eminence. But although what are transmitted to us under the title of his works may have been written by different hands, yet the presumption is, that most, if not all of them, are of nearly as early a date, and contain the prevailing opinions of those times.

His writings.

But.

According to the most authentic account, Hippocrates was a native of the island of Cos, and born in the beginning of the 83th Olympiad.

His idea of Nature.

In the writings transmitted to us as his, we find a general principle adopted, to which he gives the name of Nature. To this principle he ascribes a mighty power. "Nature," says he, "is of itself sufficient to every animal." Upon this footing, as if Nature had been a principle endowed with sense, he gives her the title of wife; and ascribes virtues or powers to her, which are her servants, and by means of which she performs all her operations in the bodies of animals: and distributes the blood, spirits, and heat, through all parts of the body, which by these means receive life and sensation. And in other places he tells us, that it is this faculty which

which gives nourishment, preservation, and growth, to all things.

The manner in which Nature acts, or commands her subservient powers to act, is by attracting what is good and agreeable to each species, and by retaining, preparing, and changing it; and on the other side in rejecting whatever is superfluous or hurtful, after she has separated it from the good. This is the foundation of the doctrine of depuration, concoction, and crisis in fevers, so much insisted upon by Hippocrates, and many other physicians.

As far as he attempts to explain the causes of disease, he refers much to the humours of the body, particularly to the blood and the bile. He treats also of the effects of sleep, watchings, exercise, and rest, and all the benefit or mischief we may receive from them. Of all the causes of diseases, however, mentioned by Hippocrates, the most general are *diet* and *air*. On the subject of diet he has composed several books, and in the choice of this he was exactly careful; and the more so, as his practice turned almost wholly upon it. He also considered the air very much; he examined what winds blew ordinarily or extraordinarily; he considered the irregularity of the seasons, the rising and setting of stars, or the time of certain constellations; also the time of the solstices. and of the equinoxes; those days,

*Of the causes
of diseases.*

in his opinion, producing great alterations in certain distempers.

*It is divisions
of a reason*

He does not, however, pretend to explain how from these causes, that variety of distempers arises which is daily to be observed. All that can be gathered from him with regard to this is, that the different causes above mentioned, when applied to the different parts of the body, produce a great variety of distempers. Some of these distempers he accounted mortal, others dangerous, and the rest easily curable, according to the cause from whence they spring, and the parts on which they fall. In several places also he distinguishes diseases from the time of their duration, into acute or short, and chronical or long. He likewise distinguishes diseases by the particular places where they prevail, whether ordinary or extraordinary. The first, that is, those that are frequent and familiar to certain places, he called endemic diseases; and the latter, which ravaged extraordinarily sometimes in one place, sometimes in another, which seized great numbers, at certain times, he called epidemic diseases; and of this kind the most terrible is the plague. He likewise mentions a third kind, the opposite of the former; and these he calls sporadic, or flagging diseases: these last include all the different sorts of distempers which invade at any one season, which are sometimes of one sort,

fort, and sometimes of another. He distinguished between those diseases which are hereditary, or born with us, and those which are contracted afterwards; and likewise between those of a kindly and such as are of a malignant nature, the former of which are easily and frequently cured, but the latter give the physicians a great deal of trouble, and are seldom overcome by all their care.

Hippocrates remarked four stages in distempers; viz. the *beginning* of the disease, its *augmentation*, its *height*, and its *declination*. In such diseases as terminate fatally, death comes in place of the declination. In the third stage, therefore, the change is most considerable, as it determines the fate of the sick person, and this is most commonly done by means of a *crisis*. By this word he understood any sudden change in sickness, whether for the better or for the worse, whether health or death succeed immediately. Such a change, he says, is made at that time by Nature, either absolving or condemning the patient. Hence we may conclude that Hippocrates imagined diseases to be only a disturbance of the animal economy, with which Nature was perpetually at variance, and using her utmost endeavours to expel the offending cause. Her manner of acting on these occasions is to reduce to their natural state those humours whose discord occasions the disturbances of the whole body.

body, whether in relation to their quantity, quality, mixture, motion, or any other way in which they become offensive. The principal means employed by nature for this end is what Hippocrates calls concoction. By this he understands the bringing the morbid matter lodged in the humours to such a state, as to be easily fitted for expulsion by whatever means is most proper. When matters are concocted in this pass, whatever is superfluous is immediately emptied off, and opens up the way by which it is to be accomplished. The operation is performed either by bleeding, vomiting, sweating, evacuations, tumours or cutaneous eruptions, or spots, &c. But there are many cases in which, as the effects of a true crisis, a considerable quantity of small discharges are being sufficient to make a crisis. On the contrary, small discharges are a sign, that Nature is oppressed by the load of her toils, and that she lets them go through weakness, not continual irritation. What comes forth in this manner is crude, because the distemper is yet too strong; and while matters remain in this state, nothing but a *bad or imperfect crisis* is to be expected. This shows that the distemper triumphs, or at least is equal in strength to nature, which prognosticates death, or a prolongation of the disease. In this last case, however, Nature often has an opportunity

portunity of attempting a new crisis more happy than the former, after having made fresh efforts to advance the concoction of the humours.—It must here be observed, however, that according to Hippocrates, concoction cannot be made but in a certain time, as every fruit has a limited time to ripen, for he conceives the humours which are compared to fruits come to maturity.

Hippocrates carefully remarked the *critical* *Critical days.* days, in which fevers were to be expected. He says we have a crisis were the third, fifth, seventh, ninth, eleventh, fourteenth, seventeenth, and twentieth. If this happened kindly, he says, it saves the patients, he remarked, but, if not, if they sink under their

illness, he has carefully contributed to procure a cure. His accuracy in prognostics, is generally paid to Hippocrates, is his merit in entering into the most minute circumstances of diseases and his exactness in nicely describing every thing that happened before, and every accident that appeared at the same time with them, and likewise what appeared to give ease, and what to increase the malady: which is what we may call *writing the history of a disease*. Thus he not only distinguished one disease from another by the signs which properly belonged to each; but by comparing the same sort of distemper which happened to several persons, and the accidents which usually appeared before and

after, he could often foretel a disease before it came, and afterwards give a right judgment of the event of it. By this way of *prognosticating*, he came to be exceedingly admired: and this he carried to such a height, that it may justly be said to be his master-piece; and Celsus, who lived long after him, remarks, that succeeding physicians, though they found out several new things relating to the management of diseases, yet were obliged to the writings of Hippocrates for all that they knew of signs.

From this account of Hippocrates, it will appear, that he was not near so much taken up with reasoning on the phenomena of diseases, as with reporting them. He was content to observe these phenomena accurately, to distinguish diseases by them, and judged of the event by comparing them exactly together. For his skill in prognostics he was indeed very remarkable, as we have already mentioned, inasmuch that he and his pupils were looked upon by the vulgar as prophets. What adds very much to his reputation is, that he lived in an age when physic was altogether buried in superstition, and yet he did not suffer himself to be carried away by it; on the contrary, on many occasions, he expresses his abhorrence of it.

Having thus seen in what Hippocrates makes the difference between health and sickness to consist, and likewise the most remarkable signs from

from whence he drew his prognostics, we must now consider the means he prescribed for the preservation of health, and the cure of diseases: One of his principal maxims was this, That, to preserve health, we ought not to overcharge ourselves with too much eating, nor neglect the use of exercise and labour. In the next place, That we ought by no means to accustom ourselves to too nice and exact a method of living; because those who have once begun to act by this rule, if they vary in the least from it, find themselves very ill; which does not happen to those who take a little more liberty, and live somewhat more irregularly. Notwithstanding this, he does not neglect to inquire diligently into what those who were in health used for food in his time. Here we cannot help taking notice of the prodigious disparity between the delicacy of the people in our days and in those of Hippocrates: for he takes great pains to tell the difference between the flesh of a dog, a fox, a horse, and an ass; which he would not have done if at that time they had not been used for victuals, at least by the common people. Besides these, however, Hippocrates speaks of all other kinds of provision that are now in use; for example, salads, milk, whey, cheese, flesh as well of birds as of four-footed beasts, fresh and salt fish, eggs, all kinds of pulse, and the different kinds of grain we feed on, as well as the

*His maxims
for the pre-
servation of
health.*

Diet

different sorts of bread that are made of it. He also speaks very often of a sort of liquid food, or broth, made of barley-meal, or some other grain, which they steeped for some time, and then boiled in water. With regard to drink, he takes a great deal of pains to distinguish the good waters from the bad. The best, in his opinion, ought to be clear, light, without smell or taste, and taken out of the fountains that turn towards the east. The salt-waters, those that he calls hard, and those that rise out of fenny ground, are the worst of all; he condemns also those that come from melted snow. But though Hippocrates makes all those distinctions, he advises those who are in health to drink of the first water that comes in their way. He advises to mix wine with an equal quantity of water: and this (he says) is the just proportion; by using which the wine will expel what is hurtful to the body, and the water will serve to temper the acrimony of the humours.

For those that are in health, and likewise for such as are sick, Hippocrates advises exercise. The books, however, which treat on this subject, some conjecture, to have been written by Herodicus, who first introduced gymnastic exercise into medicine. The advice given, consists mostly in directions for the times in which we ought to walk, and the condition we ought to be in before it; when we ought to walk slowly, and

when to run, &c.; and all this with respect to different ages and temperaments, and with design to bring the body down, or dissipate the humours. Wrestling, although a violent exercise, is numbered with the rest. In the same place also mention is made of a play of the hands and fingers, which was thought good for health, and called *chironomic*; and of another diversion which was performed round a sort of ball hung up, which they called *corycus*, and which they struck forward with both their hands.

With regard to those things which ought to be separated from, or retained in the human body, Hippocrates observes, that people ought to take great care not to load themselves with too much food too long retained; and besides the exercise above mentioned, which carries off one part of them, and which he prescribed chiefly on this account, he advises people to excite and rouse up nature when she flagged, and did not endeavour to expel the other, or take care of the impediments by which she was resisted. For this reason he prescribed meats proper for loosening the belly; and when these were not sufficient, he directed aperient medicines.

In his writings are likewise to be found several remarks concerning good and bad air; and he makes it appear that the good or bad disposition of this element does not depend solely on the difference

ference of the climate, but on the situation of every place in particular.

Regions.

He speaks also of the good and bad effects of the passions, and recommends moderation in regard to them.

Practice of Hippocrates.

From what we have already related concerning the opinions of Hippocrates, it may naturally be concluded, that for the most part he would be contented with observing what the strength of Nature is able to accomplish without being assisted by the physician. That this was really the case, may be easily perceived from a perusal of his book entitled, "Of epidemic distempers;" which is, as it were, a journal of the practice of Hippocrates; for there we find him often doing nothing more than describing the symptoms of a distemper, and informing us what has happened to the patient day after day, even to his death or recovery, without speaking a word of any kind of remedy. Sometimes, however, he did indeed make use of remedies; but these were exceedingly simple and few, in comparison of what have been given by succeeding practitioners. These remedies we shall presently consider, after we have given an abridgment of the principal maxims upon which his practice is founded.

His maxims for the cure of diseases.

Hippocrates asserted in the first place, That contraries, or opposites, are the remedies of each other; and this maxim he explains by an apho-

risin; in which he says, that evacuations cure
 those distempers which come from repletion, and
 repletion those that are caused by evacuation.
 So heat is destroyed by cold, and cold by heat,
 &c. In the second place, he asserted, that phy-
 sic is an addition to what is wanting, and a sub-
 traction or retrenchment of what is superfluous,
 an axiom which is explained by this, viz. that
 there are some juices or humours, which in par-
 ticular cases ought to be evacuated, or driven
 out of the body, or dried up; and some others
 which ought to be restored to the body, or caused
 to be produced there again. As to the method
 to be taken for this addition or retrenchment, he
 gives this general caution, That you ought to be
 careful how you fill up, or evacuate all at once,
 or too quickly, or too much; and that it is equally
 dangerous to heat, or cool again on a sudden;
 every thing that runs to an excess, says he, being
 an enemy to Nature. In the fourth place, Hip-
 pocrates allowed that we ought sometimes to di-
 late, and sometimes to lock up: to dilate, or
 open the passages by which the humours are
 voided naturally, when they are not sufficiently
 opened; or when they are closed; and, on the
 contrary, to lock up or straiten the passages when
 they are relaxed, when the juices that pass there ought
 not to pass, or when they pass in too great quan-
 tity. Hippocrates gives also the following in-
 struction, That when we do any thing accord-
 ing

ing to reason, though the success be not answerable, we ought not too easily, or too hastily, to alter our manner of acting, as long as the reasons for it seem good. But as this maxim might sometimes prove deceitful, he gives the following as a corrector to it: We ought (says he) to mind with a great deal of attention what gives ease, and what creates pain; what is easily supported, and what cannot be endured. We ought not to do any thing rashly; but ought often to pause, or wait, without doing any thing: by this way, if you do the patient *no good*, you will at least do him *no hurt*.

These are the principal and most general maxims of the practice of Hippocrates, and which proceed upon the supposition laid down at the beginning, viz. "*that Nature cures diseases.*" We next proceed to consider particularly the remedies employed by him, which will serve to give us a further insight concerning his practice.

*His maxims
respecting
diet in dis-
eases.*

Diet was the first, the principal, and often the only remedy made use of by this great physician to answer the greatest part of the intentions above mentioned: by means of it he opposed strength to disease, and supported Nature to overcome the malady. The dietetic part of medicine was so much the invention of Hippocrates himself, that he says expressly, the ancients had wrote almost nothing concerning the diet of the sick, having

omitted

omitted this point, though it was one of the most essential parts of the art.

The diet prescribed by Hippocrates for patients labouring under acute distempers, differed from that which he ordered for those afflicted with chronic ones. In the former, which require a more particular exactness in relation to diet, he preferred liquid food to that which was solid. For these he used a sort of broth made of cleansed barley; and to this he gave the name of *Ptisan* *. He preferred the ptisan to all other food in fevers, because it softened and moistened much, and was besides of easy digestion. If he was concerned in a continual fever, he would

* The manner in which the ancients prepared their ptisan was as follows. They first steeped the barley in water till it was plumped up, and afterwards they dried it in the sun, and beat it to take off the husk. They next ground it; and having let the flour boil a long time in the water, they put it out to the sun, and when it was dry they pressed it close. It is properly this flour so prepared that is called *ptisan*. They did almost the same thing with wheat, rice, lentils, and other grain: and they gave these ptisans the name of the grain from whence they were extracted, as *ptisan of lentils, rice, &c.* but the ptisan of barley was called simply *ptisan*, on account of the excellency of it. When they wanted to use it, they boiled one part of it in ten or fifteen of water; and when it began to grow plump in boiling, they added a little vinegar, and a very small quantity of anise or fennel, to keep it, as they thought, from clogging or filling the stomach with wind.

have

have the patient begin with a ptisan of a pretty thick consistence, and go on by little and little, lessening the quantity of barley-flour as the height of the distemper approached; so that he did not feed the patient but with what he called the *juice of the ptisan*, that is, the ptisan strained, where there was but very little of the flour remaining, in order that Nature being discharged in part from the care of digesting the aliments, she might the more easily hold out to the end, and overcome the distemper or the cause of it. In the paroxysm of a fever he gave nothing at all, and in all distempers where there are exacerbations, he forbids nourishment while the exacerbations continue. He let children eat more, but those who were grown up to man's estate, or were of an advanced age, less, making allowance, however, for the custom of each particular person, or for that of the country.

But though he was of opinion that too much food ought not to be all wed to the sick, he was not of the mind of some physicians who prescribed long abstinence, especially in the beginning of fevers. The reason he gave of this was, that the contrary practice weakened the patients too much during the first days of the distemper, by which means their physicians were obliged to allow them too much food when the illness was at its height, which in his opinion was improper. Besides, in acute distempers, and particularly in fevers,

fevers, Hippocrates made choice of refreshing nourishment; and amongst other things prescribed orange, melon, spinach, gourd, and dock.

The drink he commonly gave to his patients was made of eight parts of water and one of honey. In some distempers they added a little vinegar.

Drinks

These are the most remarkable particulars concerning the diet prescribed by Hippocrates in acute distempers; in chronical ones he made use very much of milk and whey; though we are not certain whether this was done on account of the nourishment expected from them, or that he accounted them as medicines.

Diet in chronic diseases.

There are many diseases for which he judged the bath was a proper remedy; and he takes notice of all the circumstances that are necessary in order to cause the patient to receive benefit from it, among which the following are the principal. The patient that bathes himself must remain still and quiet in his place without speaking while the assistants are wiping him dry. He must not bathe immediately after eating and drinking, nor eat or drink immediately after coming out of the bath. Regard must also be had whether the patient had been accustomed to bathe while in health, and whether he has been benefited or hurt by it. Lastly, he must abstain from the bath when the body is too open, or too close,

His maxims respecting bathing.

or when he is too weak; or if he has an inclination to vomit, a great loss of appetite, or bleeds at the nose,

*His maxims
respecting
exercise.*

In chronical distempers Hippocrates approved Very much of exercise, though he did not allow of it in acute ones: but even in these he did not think that a patient ought always to lie a-bed; but tells us, that "we must sometimes order the timorous out of bed, and rouse up the lazy."

*His maxims
respecting
purgatives.*

When he found that diet and exercise were not sufficient to ease nature of a burden of corrupted humours, he was obliged to make use of other means, of which purgation was one. By this word he understood all the contrivances that are made use of to discharge the stomach and bowels; though it commonly signifies only the evacuation of the body. Most of the purgatives used in his time were emetics also, or at least were very violent in their operation downwards. These were the white and black hellebore; the first of which is now reckoned among the poisons. He used also the Cnidian berries, which are nothing else but the seeds of thymelea or chamœlea; cneorum peplum, which is a sort of milk-thistle; thapsia; the juice of hippophaë, a sort of rhamnus; elaterium, or juice of the wild cucumber; flowers of brass, coloquintida, scammony, the magnesian stone, &c.

As these purgatives were all very strong, Hippocrates

poocrates was extremely cautious in their exhibition. He did not prescribe them in the dog-days; nor did he ever purge women with child, and very seldom children or old people. He principally used purgatives in chronical distempers; but was much more wary in acute ones. In his books intitled "Of Epidemical Distempers," there are very few patients mentioned to whom he gave purgative medicines. He also takes notice expressly, that these medicines having been given in cases of the distempers of which he was treating, had produced very bad effects. We are not, however, from this to conclude, that Hippocrates absolutely condemned purging in acute distempers; for in some places he expressly mentions his having given them with success. He was of opinion, for instance, that purging was good in a pleurisy; and in this case he gave black hellebore, or some peplum mixed with the juice of *laserpitium*.

Hippocrates imagined that each purgative medicine was adapted to the carrying off some particular humour; and hence the distinction of purgatives into *hydragogue*, *cholagogue*, &c. which is now justly exploded. In consequence of this notion, which prevailed long after his time, he pretended that we knew if a purgative had drawn from the body what was fit to be evacuated according as we found ourselves well or ill upon it. If we found ourselves well, it was a sign

that the medicine had effectually expelled the offending humour. On the contrary, if we were ill, he imagined, whatever quantity of humour came away, that the humour which caused the illness still remained; not judging of the goodness or badness of a purge by the quantity of matters that were voided by it, but by their quality and the effect that followed after it*.

Vomits were also pretty much used as medicines by Hippocrates. He seldom, as we before observed, used them with a single intent: for when he had a mind to recal the humours, as he termed it, from the inmost recesses of the body, he made use of brisker remedies. Among these was white hellebore, and this indeed he most frequently used to excite vomiting. He gave this root particularly to melancholy and mad people; and from the great use made of it in these cases by Hippocrates and other ancient physicians, the phrase *to have med of hellebore*, became a proverbial expression for being out of one's senses. He gave it also in defluxions, which come, according to him, from the brain, and throw themselves on the nostrils or ears, or fill the mouth with saliva, or that cause stubborn pains in the head, and a weariness or an extraordinary heaviness, or a weak-

* Even Hippocrates, we find, had some kind of theory, which in some measure guided his practice; although he is generally reputed to be the father of the empiric sect.

nels of the knees, or a swelling all over the body. He gave it to consumptive persons in broth of lentils, to such as were afflicted with the dropsy, called *leucophlegmatia*, and in other chronical disorders. But we do not find that he made use of it in acute distempers, except in the cholera morbus, where he says he prescribed it with benefit. Some took this medicine fasting; but most took it after supper, as was commonly practised with regard to vomits taken by way of prevention. The reason why he gave this medicine most commonly after eating was, that by mixing with the aliments, its acrimony might be somewhat abated, and it might operate with less violence on the membranes of the stomach. With the same intention also he sometimes gave a plant called *sejimouli*, and sometimes mixed it with hellebore. Lastly, in certain cases he gave what he called *soft* or *sweet* hellebore. This term had some relation to the quality of the hellebore, or perhaps to the quantity he gave of it.

When Hippocrates intended only to keep the body open, or evacuate the contents of the intestines, he made use of simples; as for example the herb mercury, or cabbage; the juice or decoction of which he ordered to be drank. For the same purpose he used whey, also cows and asses milk, adding a little salt to it, and sometimes letting it boil a little. If he gave

asses milk alone, he caused a great quantity of it to be taken, so that it must of necessity loosen the body. In one place he prescribes no less than *nine pounds* of it to be taken as a laxative, but does not specify the time in which it was to be taken. With the same intention he made use of suppositories and clysters. The former were compounded of honey, the juice of the herb mercury, of nitre, powder of colocynth, and other sharp ingredients, to irritate the rectum. These they formed into a ball, or into a long cylindrical mass. The clysters he made use of for sick people were sometimes the same with those just mentioned as preventives for people in health. At other times he mixed the decoction of herbs with nitre, honey, and oil, or other ingredients, according as he imagined he could by that means attract, wash, irritate, or soften. The quantity of liquor he ordered was about 36 ounces; from which it is probable he did not intend that it should all be used at one time.

On some occasions Hippocrates proposed to purge the head alone. This practice he employed, after purging the rest of the body, in an apoplexy, inveterate pains of the head, a certain sort of jaundice, a consumption, and the greatest part of chronical distempers. For that purpose he made use of the juices of several plants, as celery, to which he sometimes added aromatic drugs, making the patients swallow this mixture

into their nostrils. He used also powders compounded of myrrh, the flowers of brass, and white hellebore, which he caused them to put up into the nose, to make them sneeze, and to draw the phlegm from the brain. For the same purpose also he used what he calls *tetragonon*, that is, "something having four angles;" but what this was, is now altogether unknown, and was so even in the days of Galen. The latter physician, however, conjectures it to be antimony, or certain flakes found in it.

In the distemper called *empyema* (or a collection of matter in the breast), he made use of a very rough medicine. He commanded the patient to draw in his tongue as much as he was able; and when that was done, he endeavoured to force into the stomach a medicine that would irritate the part, which, raising a violent cough, obliges the lungs to discharge the purulent matter contained in them. The materials that he used for this purpose were of different sorts; sometimes he took the root of arum, which he ordered to be boiled with a little salt, in a sufficient quantity of water and oil; dissolving a little honey in it. At other times, when he intended to affect more strongly, he took the flowers of copper and hellebore; after that he shook the patient violently by the shoulders, the better to loosen the pus. This remedy, according to Galen, he received from the Chidian phy-

ficians; and it has never been used by the succeeding ones, probably because the patients could not allow of it; a sea voyage answering the purpose better.

Blood-letting was another method of evacuation pretty much used by Hippocrates. Another aim he had in this, besides the mere evacuation, was to divert or recall the course of the blood when he imagined it was going where it ought not. With regard to this evacuation, his conduct was much the same as to purging, in respect of time and persons. We ought, says he, to let blood in acute distases, when they are violent, if the party be lusty and in the flower of his age. We ought also to have regard to the time, both in respect to the disease and to the season in which we let blood. He also informs us, that blood ought to be let in great pains, and particularly in inflammations. Among these he reckons such as fall upon the principal viscera, as the liver, lungs, and spleen, as also the quinsy and pleurisy, if the pain of the latter be above the diaphragm. In a quinsy he bled in both arms at once. Difficulty of breathing he also reckons among the distempers that require bleeding; and he mentions another sort of inflammation of the lungs, which is accompanied with great heat in that part, in which case he advises to bleed in all parts of the body; and directs particularly to the arms, tongue, and nostrils.

nostrils. To make bleeding the more useful in all pains, he directed to open the vein nearest the part affected; in a pleurisy he directs to take blood from the arm of the side affected; and for the same reason, in pains of the head, he directs the veins of the nose and forehead to be opened. When the pain was not urgent, and bleeding was advised by way of prevention, he directed the blood to be taken from the parts farthest off, with a design to divert the blood insensibly from the seat of pain. The highest burning fevers, which show neither signs of inflammation nor pain, he does not rank among those distempers that require bleeding. On the contrary, he maintains that a fever itself is in some cases a reason against bleeding. If any one, says he, has an ulcer in the head, he must bleed, *unless he has a fever*. He says further, those that lose their speech of a sudden, must be blooded, unless they have a fever. Perhaps he was afraid of bleeding in fevers, because he supposed that they were produced by the bile and pituita, which heated the whole body, which is, says he, what we call *fever*, and which in his opinion cannot well be evacuated by bleeding. In other places also he looks upon the presence or abundance of bile to be an objection to bleeding; and he orders to forbear venesection even in a pleurisy, if there be much bile. To this we must add, that Hippocrates distinguished very particularly between

tween a fever which followed no other distemper, but was itself the original malady, and a fever which came upon inflammation. In the early ages of physic, the first were only properly called fevers: the others took their names from the parts affected, as pleurisy, peripneumony, hepatitis, nephritis, &c. which names signify that the pleura, the lungs, the liver, or the kidneys, are diseased, but do not intimate the fever which accompanies the disease. In this latter sort of fever Hippocrates constantly ordered bleeding, but not in the former. Hence, in his books of Epidemic Distempers, we find but few directions for bleeding in the great number of continual and burning fevers there treated of. In the first and third book we find but one single instance of bleeding, and that in a pleurisy; in which, too, he staid till the eighth day of the distemper.

With regard to the rules laid down by Hippocrates for bleeding, we must further take notice, that in all diseases which had their seat above the liver, he bled in the arm, or in some of the upper parts of the body; but for those that were situated below it he opened the veins of the foot, or ankle. If the belly was too laxative, and bleeding was at the same time thought necessary, he ordered the looseness to be stopped before bleeding.

Hippocrates let blood also in a dropsy, even in a tympany; and in both cases he prescribes bleeding

bleeding in the arm. In a disease occasioned by an overgrown spleen, he proposes bleeding several times repeated at a vein of the arm which he calls the *splenic*. On some occasions he took away great quantities of blood, as appears from what we have already observed. Sometimes he continued the bleeding till the patient fainted: at other times he would let blood in both arms at once; at others, he did it in several places of the body, and at several times. The veins he opened were those of the arm, the hands, the ancles on both sides, the hams, the forehead, behind the head, the tongue, the nose, behind the ears, under the breasts, and those of the arms; besides which, he burnt others, and opened several arteries. He likewise used cupping-vessels, with intent to recal or withdraw the humours which fell upon any part. Sometimes he contented himself with the bare attraction made by the cupping-vessels, but sometimes he also made scarifications.

When bleeding and purging, which were the principal and most general means used by Hippocrates, proved insufficient, he had recourse to diuretics and sudorifics. The former were of different sorts, according to the constitution of the persons: sometimes baths, and sometimes sweet wine, were employed to provoke urine; sometimes the nourishment which we take contributes to it: and amongst those herbs which
are

*H. maxim.
re po'ling
di' rai s' anu
u' lorifos.*

are commonly eaten, Hippocrates recommends garlic, leeks, onions, cucumbers, melons, gourds, fennel, and all other things which have a lemon taste and a strong smell. With these he counts honey, mixed with water or vinegar, and all meats. But, on some occasions, he used the cantharides, and, pulling off their sting, he would give them in wine and honey. These remedies were given in a great number of instances, and at different tempers, after purging, in large quantities, and when it was made in less quantities, it was not thought. There were also some cases in which he would force sweat as well as urine: but he does not mention the diseases in which this was proper, nor lets us know what remedies he would be used for this purpose. In the third book of his passage, where he mentions a fever, he proposes upon the head a great quantity of sweat, till the feet sweat; that is, till the sweat runs down over the whole body, reaching to the head and feet. After this he would have the patient eat baked meat, and drink pure wine, and being well covered with clothes, lay themselves down to rest. The disease for which he proposes the above mentioned remedy is a fever; which is not, according to him, produced by bile or pituita, probably he meant rheumatism; from whence we may conclude that he did not approve of sweating in any other kind of fever.

Lastly,

Lastly, besides the medicines already mentioned, which acted in a sensible manner, Hippocrates made use of others called specifics; whose use he did not see, and for the use of which he could give no reason besides his own experience, or that of other physicians. These he borrowed from his predecessors the descendants of Asclepiades, who, being *empirics*, did not trouble themselves about inquiring into the operation of their remedies, provided their patients were cured: so these he joined *anodynes*, or such things as procure sleep: but these last were used in great caution, and, it is most probable, were only in the most violent operations of poppies.

The use he made of specifics and anodynes.

The compound medicines given inwardly by Hippocrates were either *liquid*, *solid*, or *lambative*. The liquid ones were prepared either by decoction or infusion in a proper liquor, which, when finished was to be used; or by macerating certain powders in such liquors, and so taking them together, or by joining different kinds of liquors together. The solid medicines consisted of juices inspissated, of gums, resins, or powders, made up with them or with honey, or something proper to give the necessary consistence to the medicine. These were made up in a form and quantity fit to be swallowed with ease. The lambative was of a consistence between solid and fluid; and the patients were obliged to keep it for some time to dissolve in the mouth, that

Of compound medicines.

they might swallow it leisurely. This remedy was used to take off the acrimony of those humours which sometimes fall upon this part, and provoke coughing and other inconveniences. The basis of this last composition was honey. It is worth our observation, that the compound medicines of Hippocrates were but very few, and composed only of four or five ingredients at most; and that he not only understood pharmacy, or the art of compounding medicines, but prepared such as he used himself, or caused his servants to prepare them in his house by his directions.

We have thus given some account of the state of medicine as practised and taught by Hippocrates, who, as we have already observed, has for many ages been justly considered as the father of physic. For when we attend to the state in which he found medicine, and the condition in which he left it, we can hardly bestow sufficient admiration on the judgment and accuracy of his observations.

*Character of
Hippocrates.*

The divine Hippocrates is always sure to represent things as they are in their own natures. He has no interested views to serve, no particular bias to draw him aside from truth. He is always clear, always concise, and intelligible. He no where obscures his meaning, throws a cloud over the nature of disorders, or misrepresents their symptoms and terminations, by the unintelligible jargon of the four elements, or the still more

more absurd and ridiculous whim of the four primary qualities resulting from them. Vain and idle controversies concerning the first temperament of the simple stamina of life never hinder him from penetrating into the true events of things. The purity and glory of his compositions are not stained and sullied with the useless notions of the *calidum innatum*, and the *humidum radicale*. Subtile and uninstruative distinctions of diseases, and their several causes, are not to be met with in the works of this venerable parent of the healing art. These were nice distinctions which his exalted genius, and well-formed taste, despised. He was no less conspicuous for the impartiality of his representations, than the force and strength of his genius, for he no-where asserts things which he had not seen, nor does he ever neglect to give a faithful account of real circumstances. He represents, but does not disguise or change, the operations of nature, in order to procure honour or stability to any particular hypothesis. We ought carefully to peruse the plain, the simple writings of Hippocrates, in which the sacred oracles of nature herself are delivered pure and uncontaminated; where nothing is darkened by an obscurity of words; where every line is richly pregnant with thought and sense; and where the most important truths are told at once with Laconic brevity, and Attic perspicuity. But there are still other circumstances
of

of greater moment, which render the divine Hippocrates fully preferable to all others: witness his unwearied and indefatigable attention of mind, which enabled him to view every circumstance in the most proper light; witness his unwearied and incomparable diligence, by which he investigated and discovered every thing which had the least tendency to clear his thoughts; witness the noble and generous freedom with which he conveyed his useful labours to the world. Whichever of these the impartial mind considers, the divine Hippocrates will be found great beyond the possibility of a rival. Among the numerous instances in which he improved both that knowledge he had received from his ancestors, and that which he had learned in foreign nations, there is one of a singular nature, and entirely peculiar to himself, which deserves to be recorded; he sent his elder son, Democritus into Thessaly, Draco his younger son to the Hellespont, Polybus his son-in-law to another quarter of Greece, and a large number of his scholars all over the country, after having duly instructed them in the principles of their art, and furnished them with every thing necessary for practice. These were ordered to cure the sick exposed on the highways, to observe the terminations of diseases, to attend carefully to the operations and effects of medicines, and to give a faithful and impartial account of all to their great and worthy countryman Hippocrates. These, to be

be sure, were a set of the most fortunate circumstances that ever yet concurred to the formation of any one physician; and Hippocrates well knew how to make the best advantage of them, for from the labours and observations of this large number of physicians, formed upon his own model, judging, as it were, with his own eyes, and practising upon his own principles, he formed, considering the times, the most perfect, the most extensive, and the most judicious body of physic. Other physicians see only with their own eyes, but Hippocrates saw also with those of others. Most practitioners draw their knowledge from a scanty number of patients, but Hippocrates was supplied from every part of Greece. Few practical authors have described the diseases which rage in a single town, but Hippocrates has judiciously adverted on all the disorders that occurred through all the towns, villages, and provinces of Greece. This is, no doubt, a sufficient reason why Hippocrates should appear so much superior to others, who were destitute of the like opportunities, and placed in less favourable circumstances: hence it happens, that his labours have stood the shocks of envy, the assaults of opposers, and the malice of critics, for so many centuries, and, like burnished steel, become the more bright and resplendent by attrition. When perused with the nicest judgment and the strictest care, the smallest inconsistency cannot be found,

and truth and nature every where appear in their most awful and commanding shapes. Upon the whole, so accurate and extensive was the skill of Hippocrates, that the learned Greeks, the polite Romans, and the industrious Arabians, have done nothing but repeat and confirm his doctrines. The Illyrians and Peonians adored him as something more than human, and Barbarian kings publicly implored him as their tutelary genius; powerful and opulent nations rewarded his merit by munificent presents; and histories inform us, that physicians have, in all ages, been recommended to potentates, and loaded with glory, honour, and riches, by treading in the steps of Hippocrates.

Galen, who flourished five hundred years after Hippocrates, although a great admirer of him, differed essentially from this great father of physic. Hippocrates was conducted chiefly by experience, and his works are a collection or record of *facts*; whereas Galen indulged in the most extravagant *theories* and idle disputations; and, as it is easy to be wrong in ratiocination, whereas experience, on the contrary, must be admitted by all parties, the works of Hippocrates have afforded very little matter of exception to the physicians who came after him, whereas the doctrine of Galen divided the faculty into two sectaries.

Galen for the most part followed the plan of Hippocrates, in the treatment of diseases. But a

the *materia medica* in the course of five hundred years had been much augmented, the prescriptions of Galen were devoid of the Hippocratic simplicity. And it is more than probable that his false and ridiculous theory, concerning the primary qualities of hot and cold, dry and moist, led him into dangerous errors in the composition of medicines.

Two great sects were in consequence established: those who followed Hippocrates were styled empirics, from the Greek word *εμπειρία*, experience (a word shamefully abused); and the other physicians, in the general acceptance of the word.

After the downfall of the Roman empire, and when the inundation of Goths and Vandals had almost completely exterminated literature of every kind in Europe, medicine, though a practical art, shared the same fate with more abstract sciences. Learning in general, banished from the seat of arms, took refuge among the eastern nations, where the arts of peace still continued to be cultivated. To the Arabian physicians, as they have been called, we are indebted both for the preservation of medical science, as it subsisted among the Greeks and Romans, and likewise for the description of some new diseases, particularly the small-pox. Among the most eminent of the Arabians, we may mention Rhazes, Avicenna, Albucasis, and Avenzoar. But of their writings it

would be tedious, and is unnecessary to give any particular account. — They were for the most part, indeed, only copiers of the Greeks; we are, however, indebted to them for some improvements. They were the first who introduced chemical remedies, though of these they used but few, nor did they make any considerable progress in the chemical art. Anatomy was not in the least improved by them, nor did surgery receive any advancement till the time of Albucasis, who lived probably in the sixth century. They added a great deal to botany and the materia medica, by the introduction of new drugs, of the aromatic kind especially, from the east, many of which are of considerable use. They also found out the way of making sugar, and by help of that, syrups; which two new materials are of great use in mixing up compound medicines.

With regard to their practice, in some few particulars they deviated from the Greeks. Their purging medicines were much milder than those formerly in use; and even when they did prescribe the old ones, they gave them in a much less dose than formerly. The same reflection may be made concerning their manner of bleeding, which was never to that excessive degree practised by the Greeks. They deviated from Hippocrates, however, in one very trivial circumstance, which produced a violent controversy. The question was, Whether blood in a pleurisy ought

ought to be drawn from the arm of the affected side or the opposite? Hippocrates had directed it to be drawn from the arm of the affected side; but the Arabians, following some other ancient physicians, ordered it to be drawn from the opposite one. Such was the ignorance of those ages, that the university of Salamanca in Spain made a decree, that no one should dare to let blood but in the contrary arm; and endeavoured to procure an edict from the emperor Charles V. to second it; alleging that the other method was of no less pernicious consequence to medicine, than Luther's heresy had been to religion.

In consequence of the general decay of learning in the western parts of the world, the Greek writers became totally forgot, because nobody could read the language; and the Arabians, though mostly copiers from them, enjoyed all the reputation that was due to the others. The Arabian physic was introduced into Europe very early, with the most extravagant applause: and not only this, but other branches of their learning, came into repute in the west; insomuch that in the 11th century, the studies of natural philosophy and the liberal arts were called *the studies of the Saracens*. This was owing partly to the crusades undertaken against them by the European princes; and partly to the settlement of the Moors in Spain, and the intercourse they and other Arabians had with the Italians. But, long

before the time of the crusades, probably in the middle of the 7th century, there were Hebrew, Arabic, and Latin professors of physic settled at Salerno: which place soon grew into such credit, that Charles the Great thought proper to found a college there in the year 802; the only one at that time in Europe. Constantine, the African, flourished here towards the latter end of the 11th century. He was a native of Carthage; but travelled into the east, and spent 30 years in Babylon and Bagdad, by which means he became master of the oriental languages and learning. He returned to Carthage; but being informed of an attempt against his life, made his escape into Apulia, where he was recommended to Robert Guiscard, created in 1060 duke of that country, who made him his secretary. He was reputed to be very well versed in the Greek, as well as the eastern tongues; and seems to have been the first who introduced either the Greek or Arabian physic into Italy. His works, however, contain nothing that is new, or material; though he was then counted a very learned man, and for that age no doubt was so.

The Arabian physicians, instead of pursuing the road which would finally conduct to a true knowledge of medicine, which is properly defined to be "the healing art," only added to the subtleties of Galen, and composed books as commentaries on him full of the most empty and unmeaning

unmeaning ideas. This suited, however, the age, for people of those days were so delighted with the extraordinary and marvellous, that they were not satisfied with what was level to their comprehensions, but required something sublime and unintelligible, which might exercise their imaginations, although it confounded their ideas; so true is the expression of Tacitus, *Quidquid ignotum vulgo pro magnifico semper habebatur*; or, as Lucianus observes,

*Omnia enim stolidi magis admirantur, amantque
Inversis quæ sub verbis latitantia cernunt.*

It is certain that the method of Hippocrates was preferable for the advancement of the science of medicine to that of Galen. Nevertheless, on the other hand, as all things depend upon some certain cause, it would be of infinite service to medicine, if these could be demonstrated and made plain beyond all possibility of contradiction: for this would give the most certain deduction for cure; but wherever theory is doubtful it cannot be trusted to in practice, and may lead into the most dangerous errors. The abuse therefore, and not the use of ratiocination, is to be condemned. Hypothesis cannot mislead men of judgment, who can distinguish it from demonstration, but theory, in the hands of men of wild imagination and weak judgment, is certainly too capable of producing much mischief.

Præfixum

Erasistratus.

Erasistratus reasoning on false and precarious principles, and neglecting experience, the sole test of utility, proscribes the use of venesection and purgatives, and condemns them as remedies equally infamous and dangerous.

Asclepiades.

Asclepiades, from whom the modern sect of mechanics have borrowed many of their doctrines, supposing that health depends on the just proportion between the pores of the body and certain corpuscles, which they are destined to receive and transmit, and that it is impaired whenever these corpuscles are obstructed in their passage, orders exercise on horseback in the most ardent fevers. He advances it as a maxim, that one fever is to be cured by raising another; and that the strength of the patient is to be exhausted by watching, and the endurance of thirst. And his practice was strictly, and severely conformable to his principles; for he would not allow the sick to cool their mouths with a drop of water, during the two first days of the disorder. But he indulged his phrenetic patients in the use of wine, even to intoxication.

Theonison.

Theonison, the disciple of Asclepiades, rejected some of the opinions of his master, and founded a new sect, called the Methodists. But his practice did not materially differ from that of Asclepiades.

Oribasius, Aetius, Alexander, Trallianus, Paulus Aegineta, and their successors the Arabian physicians, attempted no material innovations, but
humbly

humbly trod in the footsteps of Galen. The Arabians indeed introduced several new and valuable medicines into practice, such as manna, fenna, tamarinds, cassia, and rhubarb. And by the cultivation of chemistry, they laid a foundation for the greatest and most important revolutions in the art of medicine. I omit the mention of Albertus Magnus, Arnoldus de Villa Nova, Ramund Lully, Johannes de Rupefissa, Isaac and John Hollandus, and Basil Valentine, who were all chemists, many of them inventors of *panaceas*, and the authors of much mischief.

When, after many ages of darkness, which had destroyed almost the whole of ancient literature, learning was again restored in the fifteenth century, it was the system of Galen alone that the physicians of those days became acquainted with; and during the course of the sixteenth century, the study of physicians was almost solely employed in explaining and confirming that system. At this period the medical knowledge of Europe was chiefly, and, indeed, solely, such as had been derived from the Arabians. At the conquest of Constantinople by the Turks, about the middle of the fifteenth century, several of the Greeks fled into Italy, and the people of Europe communicating with them, found them to be intelligent, and some of them even learned men. The Europeans were thence led to study the Greek language, in order to read the valuable

books which these fugitives had so much extolled; and among other works, those of Galen particularly attracted the notice of the physicians, which, to their great astonishment, contained all the medical knowledge that had been attributed to the Arabians. To the Greek writers, therefore, the physicians of those times closely applied their attention, thinking these books the only true fountains of medical knowledge; and thus it was that the Galenical doctrines became prevalent all over Europe. Early, indeed, in the sixteenth century, the noted Paracelsus had laid the foundation of a chemical system which was in direct opposition to that of Galen; and, by the efficacy of the medicines employed by Paracelsus and his followers, his system came to be received by many: but the orthodox physicians continued to be chiefly Galenists, and kept possession of the schools till the middle of the seventeenth century. It is not, however, necessary here to enter into any further detail respecting the fate of those two opposite sects*, for the only circumstance concerning them, which I would wish at present to point out, is, that in the writings of both, the explanations they severally attempted to give of the phenomena of health or sickness, turned very entirely upon the state of the fluids of the body.

* This will be treated of when we come to give the progress of chemistry. Vide Sect. II. of this Volume.

Whoever

Whoever searches into the annals of physic, cannot fail of being astonished at the almost infinite variety of systems and hypotheses, which at different times have been obtruded on the world. The amazing fertility of the imagination is there displayed in its full extent; and perhaps so ample an exhibition of the powers of human invention might gratify the vanity of man, if the agreeable effect were not more than counterbalanced by the humbling view of so much absurdity, contradiction, and falsehood. The idlest opinions have had their abettors; the most groundless fictions have been swallowed with credulity. A list of all the follies which, at different periods, have been established as articles of faith in medicine, would form the severest satire on the healing art. Who can withhold his laughter when he reads of expelling, attracting, and concocting faculties; of energies, sympathies, antipathies, idiosyncrasies, and occult causes; of the body being nothing but salt, sulphur, and mercury; of man being a microcosm, and uniting in his frame the motion of the stars, the nature of the earth, of water, air, all vegetables and minerals, the constellations, and the four winds. Yet ridiculous as these several tenets may appear, they have given rise to sects, have been espoused with warmth, and defended with acrimony. But the eccentric genius of the theorist has not been confined within the limits of physiology, and the laws of the animal economy: the hidden causes

of

of diseases, the elements or first principles of medicines, and their secret mode of action on the body, have afforded another no less extensive field for the exercise of his creative imagination. The bare recital of their several fictions would sufficiently demonstrate their absurdity. But to enumerate them would be an almost endless task. Erasistratus defines disease to be a translocation of blood from the veins to the arteries; whereas Galen asserts that, as health consists in the equilibrium between dryness and moisture, heat and cold, sickness must depend upon the subversion of that equilibrium. One sect adopts plethora as the cause of all diseases; another denies the possibility of its existence in the body. Sylvius exults in the discovery that an acid is the sole morbid principle; his antagonists ascribe that honour to their alkali. Salt, sulphur, acrimonies, caustics, volatiles, ferments, &c. &c. have each, at different times and by different systematics, been received as the undoubted *principia morborum*. No less absurd are the fictions of the theorists, concerning the elements and qualities of medicines, and their operation on the body. The same drug is represented as hot in one degree and cold in another, or as dry in one proportion and moist in another. Certain remedies are whimsically assigned to particular parts of the body, on which they are supposed to exert their effects by a peculiar predilection. Hence the classes of pectorals, stomachics, hepatics, cephalics, cordials, &c.

One medicine attracts and eliminates the bile another the *pituita*, and a third the *atra bilis* or melancholy. Some preparations irradiate the animal spirits, others *darken* and *obscure* them. But enough of these idle conceits, the offspring of theory, and the disgrace of physic!

At length SYDENHAM appeared, who adopted the plan of Hippocrates. At this time the theory of all fevers being an effort to concoct and throw out what was injurious to the frame, was almost universal. Hence it became a *desideratum*, to expel this unknown enemy out of the system; and as it was observed, that acute distempers are sometimes terminated by a critical sweat, it was concluded, that the most powerful sudorifics were the best means of accomplishing this desirable end. This gave rise to the destructive and fatal practice, which was universal, of administering heating remedies, in diseases of an inflammatory nature; a practice productive of great devastation amongst the inhabitants of Europe. Sydenham, the true English Hippocrates, was the first physician who had understanding and courage enough, to stem the rapid and overwhelming torrent: and we are now at last taught, by sad experience, founded on the destruction of numbers of our fellow creatures, that the cooling regimen is alone to be employed in such distempers. The small-pox affords us a remarkable example of the opposite effects of the two different methods of treatment.

And

And the amazing success which has attended the new mode of inoculation, is a proof undeniably convincing, of the excellence and safety of the one, and of the danger and frequent fatality of the other. So powerful is the action of heating remedies, in this disorder, that a single glass of mountain wine, given even after the eruption is completed, has produced an additional number of pustules.

Such was the state of the science of physic till about the middle of the seventeenth century, when the circulation of the blood came to be generally known and admitted; and this, together with the discovery of the receptacle of the chyle, and of the thoracic duct, finally exploded many errors in physic. About this period, a considerable revolution had taken place in the system of Natural Philosophy. In the course of the seventeenth century, Galileo had introduced mathematical reasoning; and Lord Bacon having proposed the method of induction, had thereby excited a disposition to observe facts, and to make experiments. These new modes of philosophising, it might be supposed, would soon have had some influence on the state of medicine; but the progress of this was slow. The knowledge of the circulation did indeed necessarily lead to the consideration as well as to a clearer view of the organic system in animal bodies; which led to the application of the mechanical philosophy to-

wards

wards explaining the phenomena of the animal economy; and it was applied accordingly, and continued till very lately, to be the fashionable mode of reasoning on the subject.

With this view it may be remarked, that, till the period just now mentioned, every physician, whether Galenist or Chemist, had been so much accustomed to consider the state and condition of the fluids, both as the cause of disease, and as the foundation for explaining the operation of medicines, that what we may term an *Humoral Pathology* still continued to make a great part of every system. In these circumstances it was soon perceived, that chemistry promised a much better explanation than the Galenic philosophy had done; and, therefore, while the latter was entirely laid aside, a chemical reasoning was every where received. Lord Bacon, with his usual sagacity, had early observed, that chemistry promised a great harvest of facts, and he therefore gave it credit; whilst the Corpuscularian philosophy, restored by Gassendi, readily united with the reasonings of the chemists; and the philosophy of Des Cartes readily united with both. From all these circumstances, an *Humoral and Chemical Pathology* came to prevail very much till the end of the last century; and has indeed continued to have a great share in our systems down to the present time.

*Theories of
Stahl, Hoff-
man, and
Boerhaave.*

It is proper now, however, to observe, that about the beginning of the present century, when every part of science came to be on a more improved and correct footing, there appeared in the writings of STAHL, of HOFFMAN, and of BOERHAAVE, three new, and considerably different, Systems of Physic; which have ever since had a great share in directing the practice of it. In order, therefore, to give a nearer view of the present state of physic, I shall offer some remarks upon these different systems, endeavouring to point out the advantages as well as the disadvantages of each, and how far they still prevail; or, according to my judgment, deserve to do so.

I shall begin with considering that of Dr. Stahl, which I think appeared first, and for a long time after was the prevailing system in Germany.

*Stahl's sys-
tem of phys-*

The chief and leading principle of this system is, that the *rational soul* of man governs the whole œconomy of his body. At all times, physicians have observed, that the animal œconomy has in itself a power or condition, by which, in many instances, it resists the injuries which threaten it; and by which it also, on many occasions, corrects or removes the disorders induced, or arising in it. This power, physicians very anciently attributed, under a vague idea, to an agent in the system, which

which they called nature, and the language of a *vis conservatrix et medicatrix nature*, has continued in the schools of medicine from the most ancient times to the present.

Dr. Stahl has explicitly founded his system on the supposition, that the power of nature, so much talked of, is entirely in the rational soul. He supposes, that, upon many occasions, the soul acts independently of the state of the body; and that, without any physical necessity arising from that state, the soul, purely in consequence of its intelligence, perceiving the tendency of noxious powers threatening, or of disorders anywise arising in the system, immediately excites such motions in the body as are suited to obviate the hurtful or pernicious consequences which might otherwise take place. By means of the nerves, the influence of the mind is extended to every part of the system, and if their action be impeded, disease is the unavoidable consequence. A superabundance and spissitude of the blood is therefore the proximate cause of sickness, as the energy of the mind is thereby diminished, and its action on the body obstructed. Hence to lessen the quantity, and break down the *viscositas* of the blood, the soul excites all its powers and excites hemorrhages, fistulas, diarrhoeas, fevers, and the like. Many of my readers may think it was hardly necessary for me to take notice of a system founded upon so fanciful an hypothesis: But there is often too much seeming

appearance of intelligence and design in the operations of the animal œconomy, that many eminent persons, as Perault in France, Gaubius in Holland, Porterfield and Simson in Scotland, and Nichols in England, have very much countenanced the same opinion, and it is therefore certainly entitled to some regard. Dr. Porterfield and Dr. Nichols have carried this theory still further. The latter, in his *prælectio de anima medica*, asserts without reserve, that the soul at first forms the body, and afterwards governs it; that she regulates and conducts all its vital and natural motions; circulates the fluids and distributes them to the different parts of the system, with such velocity and in such proportion as she judges right; and that whenever the body is disordered, she excites those conflicts and commotions, which are best adapted to restore it to health and soundness. It is not, however, necessary for me here to enter into a long confutation of this doctrine, I will therefore only add now, that whoever considers what has been said by Dr. Nichols in his *cratio de animæ medica*, and by Dr. Gaubius in some parts of his pathology, must perceive, that the admitting of such a capricious government of the animal œconomy, as these authors are inclined to suppose, would at once lead us to reject all the physical and mechanical reasoning we might employ concerning the human body. Both Dr. Stahl and his followers have been very
much

much governed by this supposition. Trusting much to the constant attention and wisdom of nature, they have proposed the *Art of curing by expectation*; have therefore, for the most part, proposed only very inert and frivolous remedies; have zealously opposed the use of some of the most efficacious, such as opium and the Peruvian bark; and are extremely reserved in the use of general remedies, such as bleeding, vomiting, &c.

Although these remarks, upon a system which may now be considered as exploded or neglected, may seem superfluous; I have been willing to give these strictures on the Stahlian system, that I might carry my remarks a little farther, and take this opportunity of observing, that, in whatever manner we may explain what have been called the operations of nature, it appears to me, that the general doctrine of *Nature curing diseases*, the so much vaunted *Hippocratic* method of curing, has often had a very baneful influence on the practice of physic; as either leading physicians into, or continuing them in, a weak and feeble practice; and at the same time superseding or discouraging the proper attempts of art. Dr. Huxham has observed, that even in the hands of Sydenham it had this effect. And although it may sometimes avoid the mischiefs of bold and rash practitioners, yet it certainly produces that caution and timidity which have ever opposed the introduction of new and efficacious remedies. I might

appe-

go farther, and shew how much the attention to the *Autocrateia*, allowed of, in one shape or other, by every sect, has corrupted the practice among all physicians, from Hippocrates to Stahl. It must, however, be sufficiently obvious, and I shall conclude the subject with observing, that although the *vis medicatrix nature* must undoubtedly be received as a fact; yet, it throws an obscurity upon a system of physic; and we ought rarely to admit of it in our practice.

To finish our remarks upon the Stahlian system, I shall shortly observe, that it did not depend entirely upon the *Autocrateia*, but also supposed a state of the body and diseases, that admitted of remedies, which under the power and direction of the soul, acted upon the organization and matter of the body, so as to cure its diseases. Upon this footing, the Stahlian pathology turned entirely upon *Plethora* and *Cacochymy* *. It was with respect to the former that they especially applied their doctrine of the *Autocrateia* in a very fanciful manner; and, with respect to the latter, they have been involved in an humoral pathology as much as the systematic physicians who had gone before them, and with a theory so incorrect as not to merit now the smallest attention. After all, I ought not to dismiss the consideration of the Stahlian system, without remarking, that as the fol-

* A depraved state of the fluids.

lowers of this system were very intent upon observing the method of nature, so they were very attentive in observing the phenomena of diseases, and have given us in their writings many facts not to be found elsewhere.

While the doctrines of Stahl were prevailing in the university of Halle, Dr. HOFFMAN, a professor in the same university, proposed a system that was very different. Frederick Hoffman was born at Hall, in the year 1660. He graduated in physic in 1681, was made professor of physic there in 1733, and filled that chair till his death in 1742. A very remarkable circumstance of his life is, that he never took fees from his patients, but was content with his stipend. He was in high repute as a practitioner, and curing the Emperor Charles VI. and Empress, and Frederick I. of Prussia, of inveterate diseases, greatly increased his reputation. His works are collected in six volumes folio, published at different times from 1748 to 1754. They abound with many useful practical directions; but at the same time contain many frivolous remarks, and an abundance of frivolous conjectural theory. He received into his system a great deal of the mechanical, Cartesian, and chemical doctrines of the systems which had appeared before: but, with respect to these, it is of no consequence to observe in what manner he modified the doctrines of his predecessors, as his improvements in these respects were nowise considerable.

siderable, and no part of them now remain; and the real value of his works, beyond what I am just now going to mention, rests entirely on the many facts they contain. However, the great merit of Dr. Hoffman's work is, that he made, or rather suggested, the idea of *spasm*, which highly deserves our attention.

There can be no sort of doubt, says Dr. Cullen, that the phenomena of the animal œconomy, in health and in sickness, can only be explained by considering the state and affections of the primary moving powers in it. It is to me surprising that physicians were so long in perceiving this, and I think we are therefore particularly indebted to Dr. Hoffman for putting us into the proper train of investigation; and it every day appears that physicians perceive the necessity of entering more and more into this inquiry.

It was this, I think, which engaged the learned Dr. BOERHAAVE to publish his work intitled *Impetum faciens*; as well as Dr. GAUBIUS to give the pathology of the *Solidum vivum*. Even the Baron Van Swieten, who has written a commentary upon Boerhaave, has, upon the same view, thought it necessary, in at least one particular, to make a very considerable change in the doctrine of his master, as he has done in his commentary upon the 755th Aphorism. In these, and in many other instances, particularly in the writings of Mr. Barthez of Montpellier, we see a vast progress

made in the study of the affections of the Nervous System, and cannot fail to perceive how much we are indebted to Dr. Hoffman for his so properly beginning it. The subject, however, is difficult: the laws of the Nervous System, in the various circumstances of the animal economy, are by no means ascertained; and, from want of attention and observation with the view to a system on this subject, the whole must appear to many as an inexplicable mystery. There is no wonder, therefore, that, on such a difficult subject, Dr. Hoffman's system was imperfect and incorrect; and has had less influence on the writings and practice of physicians since his time than might have been expected. He himself has not applied his fundamental doctrine so extensively as he might have done; and he has every where intermixed an *Humoral Pathology*, as incorrect and hypothetical as any other. Though he differed from his colleague Dr. Stahl in the fundamental doctrines of his system, it is but too evident that he was very much infected with the Stahlian doctrines of *Plthora* and *Cacochymy*, as may be observed throughout the whole course of his work; and particularly in his chapter *De Morborum generatione ex nimia sanguinis quantitate, et humorum impuritate*.

But it is needless for me to dwell any longer upon the system of Hoffman's and I am next to offer some remarks on the system of Dr. Boer-

Boerhaave, the cotemporary of both the other Systematics, and who, over all Europe, and especially in this part of the world, gained higher reputation than any others.

Dr. BOERHAAVE was a man of general erudition; and in applying to medicine, he had carefully studied the auxiliary branches of anatomy, chemistry, and botany, so that he excelled in each. Voorhoot, a small village about two miles from Leyden, gave birth to this eminent physician on the last day of the year 1668. He was educated at Leyden, and took his first degree in philosophy in 1690. His thesis on this occasion was a confutation of the doctrines of Epicurus, Hobbes, and Spinoza, in which he shewed great strength of genius and argument. Although he was at this time well qualified to enter into the church, which was his father's intention, yet he was dissident of his abilities, and chose to attend the lectures of divinity some time longer. His patrimony was exhausted, and he supported himself at the university by teaching mathematics, while he prosecuted his theological studies. This conduct was much approved by the eminent men both of the university and city, and procured for Boerhaave the friendship of Mr. Vandenburg the burgomaster of Leyden. Under the patronage, and at the persuasion of this gentleman, Boerhaave applied himself to the study of physic with great ardour and indefatigable diligence. In a short time he became

became a proficient in anatomy, chemistry, and the materia medica, which indeed are the bases of physic. Leaving Leyden, he went to the university of Harderwick in Guelderland, and there took his degree of Doctor of Physic in July 1693. On his return to Leyden he still persisted in his intention of entering into the ministry, which, luckily for the sake of physic, was frustrated by the following adventure. In a passage boat where Boerhaave was, a discourse was accidentally started about the doctrines of Spinoza, as subversive of religion; and one of the passengers, with vague invectives of blind zeal, opposed this philosopher's pretended mathematical demonstration. Boerhaave calmly asked him if he had read Spinoza's work, which he had so much derided. The bigot was suddenly struck dumb, and became fixed with silent resentment. As soon as he arrived at Leyden, he spread abroad a rumour that Boerhaave was become a Spinozist. Boerhaave finding these prejudices to gain ground, thought it more prudent to pursue the science of physic, than risk the refusal of a licence for the pulpit. He now joined the practice of physic to the theory. On the 18th of May 1701 he commenced his lectures on the Institutes of Physic. In 1709 he was created Professor of Medicine and Botany; and in 1713 he succeeded Le Mort in the Professorship of Chemistry. In forming a System of Physic, he seems to have studied diligently all the several writings of both ancient and

and modern physicians; and, without prejudice in favour of any former systems, he endeavoured to be a candid and genuine eclectic *. Possessed of an excellent systematic genius, he gave a system superior to any that had ever before appeared. As in the great extent, and seemingly perfect consistency, of system, he appeared to improve and refine upon every thing that had before been offered; and as in his lectures he explained his doctrines with great clearness and elegance, he soon acquired a very high reputation, and his doctrines were more generally received than any former had been since the time of Galen. Whoever will consider the merits of Dr. Boerhaave, and can compare his system with that of former writers, must acknowledge that he was very justly esteemed, and gave a system which was at that time deservedly valued.

But, in the progress of an inquisitive and industrious age, it was not to be expected that any system should last so long as Boerhaave's has done. The elaborate Commentary of Van Swieten on Boerhaave's system of physic, has been only finished a few years ago; and though this commentator has added many facts, and made some corrections, he has not, except in the particular mentioned above, made any improvement. It is even surprising that Boerhaave himself, though he lived near forty years after he had first

* That is, choosing whatever is good out of every system.

former system, had hardly, in all that time made any corrections of it, or additions to it.

When I first applied, says Cullen, to the study of physic, I learned only the system of Boerhaave; and even when I came to take a Professor's chair in this university, I found that system here in its entire and full force; and as I believe it still subsists in credit elsewhere, and that no other system of reputation has been yet offered to the world, I think it necessary for me to point out particularly the imperfections and deficiencies of the Boerhaavian system, in order to shew the propriety and necessity of attempting a new one.

Dr. Boerhaave's treatise of the diseases of the simple solids, has the appearance of being very clear and consistent, and was certainly considered by him as a fundamental doctrine: but, in my apprehension, it is neither correct nor extensively applicable. Not to mention the useless, and perhaps erroneous, notion of the composition of earth and gluten; nor his mistake concerning the structure of compound membranes; nor his inattention to the state of the cellular texture; all of them circumstances which render his doctrine imperfect; I shall insist only upon the whole being very little applicable to the explaining the phenomena of health or sickness. The laxity or rigidity of the simple solid does indeed take place, the different periods of life, and may perhaps upon other occasions, occur as the cause of pleurisy, mercury

case: but I presume, that the state of the simple solid is, upon few occasions, either changeable or actually changed; and that, in ninety-nine cases of an hundred, the phenomena attributed to such a change, do truly depend on the state of the *living solid*; a circumstance which Dr. Boerhaave has hardly taken notice of in any part of his works. How much this shews the deficiency and imperfection of his system I need not explain. The learned work of Dr. Gaubius, above referred to, as well as many other treatises of late authors, point out sufficiently the defects and imperfections of Boerhaave on this subject. If we consider the imperfection of Dr. Boerhaave's doctrine with respect to the state and various condition of the animal fluids; and if at the same time we reflect how frequently he and his followers have employed the supposition of an *acrimony* or *lensor* of the fluids, as causes of disease, and for directing the practice; we must, as I apprehend, be satisfied, that his system is not only deficient and incomplete, but fallacious and apt to mislead. Although it cannot be denied, that the fluids of the human body suffer various morbid changes, and that upon these, diseases may primarily depend; yet I must beg leave to maintain, that the nature of these changes was not at that time understood: that our reasonings therefore concerning them have been, for the most part, purely

* That is, chusical; and have therefore contributed nothing

thing to improve, and have often mislead, the practice of physic. In this, particularly, they have been hurtful, having withdrawn our attention from, and prevented our study of, the *motions* of the animal system, upon the state of which the phenomena of diseases do more certainly and generally depend. Whoever, then, shall consider the almost total neglect of the state of the moving powers of the animal body, and the prevalence of an hypothetical *humoral pathology*, so conspicuous in every part of the Boerhaavian System, must be convinced of its very great defects, and perceive the necessity of attempting one more correct *.

The body according to Boerhaave is chiefly composed of a conic, elastic, inflected canal, divided into similar lesser ones proceeding from the same trunk, which being at last collected into a retiform contexture, mutually open into each other, and send off two orders of vessels, lymphatics and veins, the one terminating in different cavities of the body, the other in the heart. These tubes are destined for the conveyance of the animal fluids; in the circulation of which life consists, and on whose free and undisturbed motion health depends. *Obstruction* therefore is the proximate cause of most diseases. And as it is produced either by a constriction of the vessels,

* From Cullen's preface to his Practice of Phys

or by a *lensor* in the blood, these are considered as the remote causes.

However plausible this theory may appear to be at first sight, it will be found, on a stricter examination, to be fallacious and defective. The mathematician, who calculates the projectile force of the heart, the velocity of the blood in the arteries, and the various secretions of the glands, from the known laws of fluids in motion, and the nature of tubes of different shapes and sizes, must unavoidably be exposed to a thousand mistakes. The vessels of the body are too numerous and minute to admit of an accurate mensuration; and they are perhaps every moment undergoing changes from the diversified action of that *vital power* which animates our wonderful system. Hence arises the contrariety in the computations of philosophers on this subject. Borelli reckons the resistance which the heart overcomes, in propelling the blood through the arteries and veins, to be equal to 180,000 pounds weight; Dr. Hales makes it amount to no more than 51 pounds; and Keil, though he computes the fluids of the human body to be five times more in quantity than Borelli supposes, hath reduced the sum to a single pound. One asserts that the pressure of air, overcome in ordinary respiration, is equivalent to the weight of 14000 pounds; a second thinks it to be equal only to a 100 pounds; and

* That is, critical, makes it so inconsiderable, as to be almost below

below comparison; whilst all the three appeal to mathematical demonstration. A similar diversity appears in the conclusions of the mathematicians, concerning the quantity of bile separated by the liver. To determine this point, Borelli first measures the diameter of the *ductus communis choledochus*, which he finds to be the 225th part of the diameter of the *vena cava*, just before it enters the right auricle of the heart. Hence he infers that if 7680 pounds of blood (supposing the whole mass to be twenty pounds, and to circulate sixteen times every hour) passes through the *vena cava* in twenty-four hours, the 225th part of this quantity, *i. e.* thirty-four pounds of bile, must, in the same space of time, be transmitted through the hepatic ducts: a conclusion altogether repugnant to fact and experience. And it will appear to be much more so, if we admit, with the latter mathematicians, that the vessels of the human body contain at a medium thirty pounds of blood; for then the quantity of bile, according to Borelli's method of reasoning, must amount to eighty-five pounds in one day. But in this, as in the former instance, Keil widely differs from Borelli, and with greater probability concludes, that two drachms of bile, and no more, are hourly separated from the liver. In these calculations no attention is paid to the peculiar nature of the animal fluids. Water and wine, a poisonous and wholesome liquid, are governed by the same hydraulic principles, mercury

but their effects when circulating in the body would certainly be very different. We know from experience, that the velocity of the pulse is influenced by the state of the blood. Even the accession of new chyle, after each meal quickens the action of the heart and arteries. The human body therefore is not to be considered as a mere machine; and that theory which is built on this foundation is evidently fallacious*.

And the mechanic hypothesis is also inadequate and defective; for the animal frame is incident to numberless diseases which have no dependence on obstruction. The *morbi fibræ debilis et laxæ* could not, even by Boerhaave himself, be ascribed to this cause. The dropsy, scurvy, putrid fevers, small-pox, measles, &c. are inexplicable on mechanical principles. A numerous class of diseases also depend upon the sympathetic connexion, which subsists between different parts of the body. When the stomach is out of order, languor, debility, watchfulness, the night mare, and sometimes a *cephalæa*, vertigo, or *hemikrania*, are the consequences. A rough bone stimulating

* In the Philosophical Transactions there is a table, in which the several purgatives and emetics commonly in use are enumerated and adjusted by mathematical rules, to all ages, sexes, and constitutions. The doses of the medicines are as the squares of the constitutions. And in the Edinburgh Medical Essays there is a formal attempt to correct the errors of this table.

the nerves of the great toe, hath produced epileptic fits. And it is well known that children, from the irritation of the gums in dentition, are liable to vomiting, purging, fever, and convulsions. These few instances are sufficient to shew that the body is unhappily subject to many disorders, besides those which proceed from *obstruction*. And perhaps the conclusion may be carried still further, when we consider that in the operation for the aneurism a large artery is tied up, and the circulation of the blood for some time almost totally suppressed in the part, without any material injury to health. Morgagni relates that Valsalva* affixed two ligatures to the carotids of a dog, who lived above twenty days after the operation, and might have continued longer, if he had not been killed for the purpose of dissection. Is it then to be supposed that the obstruction of a few capillaries, which are united together by an infinite number of anastomosing branches, can be productive of such fatal consequences, whilst the course of the blood is stopped in large vessels with impunity? Equally false and absurd is the mechanical hypothesis, concerning the operation of medicines, which is supposed to depend upon the size, figure, and gravity of their constituent particles. Thus chalybeates, for example, were recommended in obstructions on account of the *momentum* which they were thought to communicate to the blood. And on the same principles,

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mercury was said to break down the texture, and produce a colliquation of the animal fluids. But both these explanations, however beautiful in theory, are untrue; for, from the experiments of Girtanner*, it is evident, that they act in proportion to the *oxygen* they contain. And it is surely beyond the bounds of credibility to suppose, that a few grains of corrosive sublimate, which are light enough to be suspended and dissolved in brandy, are capable, by their *extraordinary weight*, of dissolving the *crassamentum* of the blood. But it is the genius of theory to dignify trifles, and to ascribe the most wonderful effects to the most insignificant causes. *

Happy however had it been for the world, if the medical systems, which have been obtruded on it, were only chargeable with inutility, absurdity, or falsehood. But alas! they have often misled the understanding, perverted the judgment,* and given rise to the most dangerous and fatal errors in practice. A short view of the history of physic will convince us of this melancholy truth. *

As long as PHILOSOPHY was built, not upon the substantial basis of actual experiment, but imagined properties, which were assumed as data, it was putting on new forms almost every day;

* Vide Dr. Beddoes' Translation of the 'Essays of Girtanner.

for one fanciful opinion had always a right to supplant another. Hence the best PHILOSOPHER in such days was ~~him~~ who could reason most ingeniously on occult qualities, either invented by himself, or by some favourite writer.

Lord Chancellor Bacon was the first who discovered the fallacy of this sort of philosophy. He rejected all that chimerical nonsense, which had usurped the name of philosophy, and wisely exclaimed—"Non fingendum, aut excogitandum, quid Natura feret et faciat, sed inveniedum est." That the operations of nature was not to be fancied, but diligently scrutinized. Hence, in less than the space of a century, the principle of philosophizing being altered, more light was thrown upon every branch of science, than it had received for above two thousand years before.

The discovery of the *circulation of the blood* first immortalized the name of HARVEY. It may appear wonderful, and at the same time not a little mortifying to the vanity of mankind, that a motion in the frame, which constitutes the basis of life, and which chance must have made us sensible of a thousand times, should have escaped the eyes of all who imagined themselves to be observers, and some of whom were actually such. When the doctrine of the circulation of the blood could no longer be resisted, various unsuccessful attempts were then made to prove that it was known long before ;

*Harvey's
discovery of
the circulation
of the
blood.*

so was it with Columbus who discovered a new world, which occasioned him to make this simple proposal to his opposers, namely, "*to place an egg upright.*" All attempted, but in vain. This illustrious navigator then *himself* broke the end, and "*the egg stood up.*" "*The thing,*" says he, "*is very easy when known,*" and ENVY itself was abashed. Thus attraction, the weight, and elasticity of the air, shewed themselves to the senses every day; but it required a Torricelli and a Newton to illustrate them.

Haller's discovery of the irritability of the fibre.

The next discovery of importance was the cause of this motion of the vascular system, by the illustrious Baron DE HALLER, who found it to arise from the stimulus of blood acting upon the *irritable principle* of the fibre. This useful discovery, like the former, excited the venom of a long opposition, and although founded upon *experiments*, was alike disbelieved, and when accredited, others were called in to participate in the honour.

THE DISCOVERIES OF BARON DE HALLER.

FABLES relate that Venus was wedded to Vulcan, the Goddess of beauty to the God of deformity. The tale, as some explain it, gives a double representation of art; Vulcan shewing us the *progressions* of art, and Venus the *completions*. The *progressions*, such as the hewing of stone, the grinding of colours, the fusion of metals, these all of them are laborious, and many times disgusting: the *completions*, such as the temple, the palace, the picture, the statue, these all of them are beauties, and justly call for admiration. Now if *Anatomy* and *Physiology* be arts not ending in themselves, but have a view to something farther, they must necessarily be arts of the *progressive* character. If then, in treating on them, the subject should appear *dry* rather than *elegant*, *severe* rather than *pleasing*, let it plead, by way of defence, that, though its importance may be great, it partakes from its very nature, which cannot be changed, more of the *deformed God*, than of the *beautiful Goddess*.

HARRIS.

I. OF IRRITABLE PARTS.

IRRITABILITY is one of those grand truths which is undeniably demonstrated; and *Posterity*, which alone stamps the merit of discoveries, by *abstracting of persons*, will promote *this discovery* to that rank, which its *USEFULNESS* entitles it to.

She will laugh when she observes, that after its opposers had failed in persuading us there was *no such thing*, they should endeavour to render the doctrine *odious*, by the consequence which they pretend naturally follows from it. She will be diverted to see Physicians following the example of religious Sectaries and Devotees, interesting the cause of GOD with *theirs*, and accusing of *materialism*, such as differ from them in opinion as to the pulsations of the Heart, and motion of the other organs. A certain author, well known for the greatness of his talents, and the bad use which he made of them, has endeavoured to draw *this induction*; but the illustrious De Haller, who was seriously affected at the imputation, has ably refuted the futility of such impious and absurd reasoning.

The Heart.

It is observable, that the motion of the HEART not only survives that of the organs of voluntary motion, but continues a considerable time even after it is separated from the body. Nay, after it has even ceased to palpitate, yet as it still retains a latent power of contraction, its systole and diastole may, by the application of stimuli, be alternately renewed and continued some time longer. Hence in drowning or suffocation, though the pulse be imperceptible, and life apparently extinguished, yet the heart still preserves this latent power or susceptibility of motion; for though unable to propel the blood
through

through the vascular system, yet it wants only to be gently excited by suitable stimuli to renew its action.

In the first rudiments of animal life, even before the brain is formed, the *punctum saliens* points out the embryo heart in miniature, and marks its *primæval irritability* as a sure presage of vitality.

The heart of the chick begins to move, before we dare presume, that there is any organ for distributing the nervous power. The *punctum saliens*, is the heart of the chick; it is seen beating while the body of the chick is but a rude, unformed, and gelatinous mass.

As this singular organ exhibits *irritability* the first, so it never relinquishes it till the last, and may therefore be considered as the *primum mobile* and *ultimum moriens* of the animal machine.

In animals with cold blood the *irritability* is very great, and continues a long while. The heart of a *viper* will palpitate when taken from its body twenty-four hours, and that of a *turtle* thirty or longer; and in animals whose blood is hot, it moves until the fat is rendered stiff by the cold, at which time the motions of the heart and all the other muscles commonly cease.

The celebrated Boerhaave acknowledges an active force in the *heart*, and a latent principle of motion in the pieces of it when cut, but he

nevertheless attributes this to the *nerves*, though the communication with the brain has been cut off! Dr. Whytt follows the same path, but with this difference of expression, he uses the term *irritability*, and imputes it to the *soul*, which feeling the impression of the *irritation* occasions the contraction of the fibre, the *soul* therefore with him is *devisible*, and resides in *every living part* of the body! Accordingly we find also, in other books, “All motion is owing to the *soul*, which “being sensible of stimuli contracts the fibres “which are touched, and pulls them back, to prevent their being injured *.”

However simple this theory may be, and, like the doctrine of *Phlogiston* among the chemists, however *commodious* for disembarassing us from several difficulties, yet as it is not in unison with the phænomena that are observed,* it must be rejected.

1. For, in the *first place*, the most *irritable parts* are those that are *least sensible*, and therefore not subject to the command of the soul, which ought to be quite the reverse, if the *soul* was the principle of *irritability*.

2. In the *second place*, *irritability* continues *after death*, and in parts quite *separated* from the body, and *deprived* of its *communication with the*

* This is the *Vis Medicatrix* of the old Physicians.

*brain**, for there is nothing more common than to see the heart of a frog beat, and the muscles remain irritable, after the head has been taken off, and the spinal marrow removed.

3. And *thirdly*, it is generally allowed, that the *nerves* are the organs and the *brain* the receptacle of all our sensations, the sources of all our ideas; but the *nerves* and the *brain*, as will be presently shewn, *are not irritable*, therefore *irritability has nothing in common with sensation* †.

MUSCLES are composed of longitudinal fibres which shorten themselves, and are so dis-

The Muscles.

* The heart is observed before the brain in the embryo chick, and is supposed therefore to act independent of brain. Some children have grown their full period in the womb, where there has been found after birth *no brain*. Might not *nutrition* during the foetal period serve all the purposes of *this vegetative life*? but as soon as the infant is brought into the world, where voluntary motion and sensation is required, a state *advanced above the vegetable*, the babe *without a brain* instantly perishes.

† The heart is divided into *two auricles* and *two ventricles*. The *auricles* communicate with their corresponding *ventricles*, and have *valves* to guard this passage. The *valves* on the right side are called *tricuspidals*, on the left *mitral*. These prevent the recurrence of the blood into the *auricles*. The *auricles* and *ventricles* may be said to be hollow muscles, or rather may be compared to two hollow cavities on each side formed of one muscle, and the left cavities or muscles are more abundantly furnished with fibres, because a greater force is required to propel the blood through the body than the lungs.

posed,

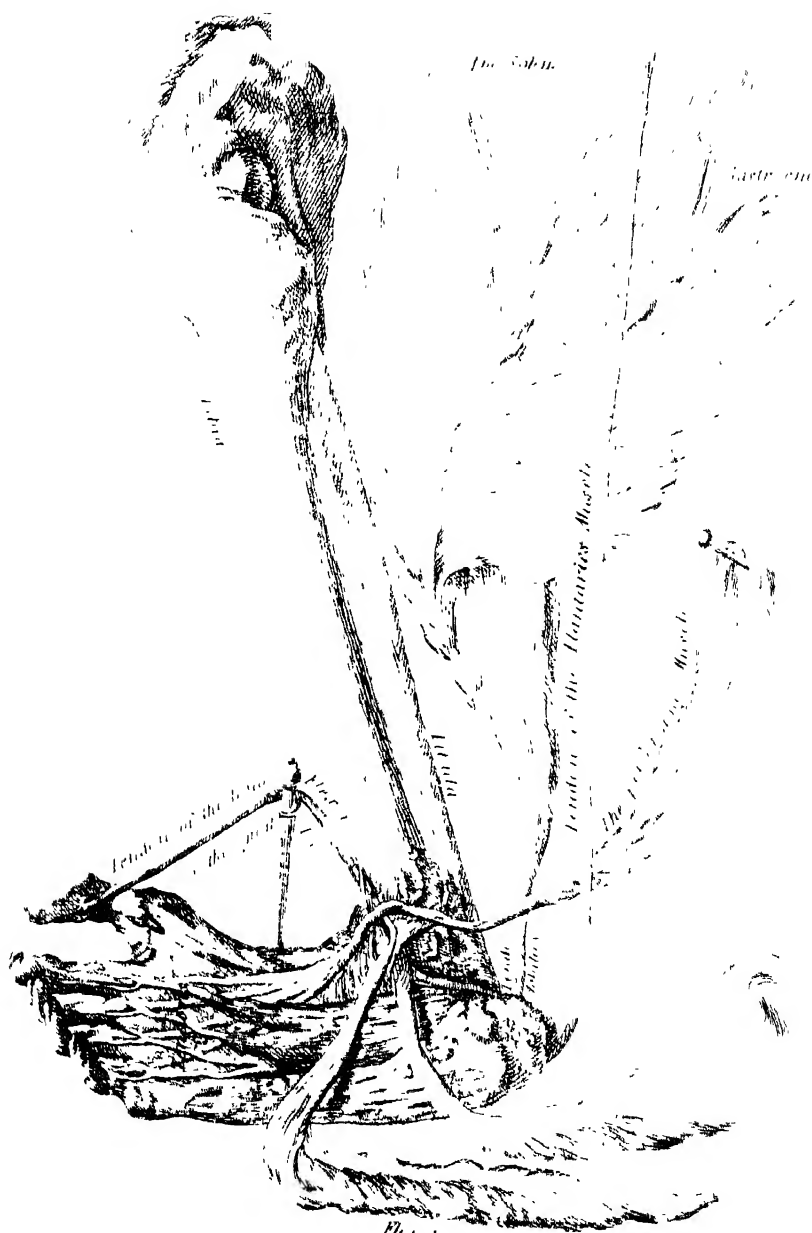
posed that this contraction always serves some wise purpose. They elegantly terminate in tendons, which are braced by sheaths, and though so numerous, each occupies its proper place and just direction.

Colour was believed to be essential to the constitution of a *Muscle*. But in fowls, in amphibious animals, in fishes, in worms and insects, through all the gradations of animals, of different species, of different sizes, the colours of the muscular fibre change. In fishes, and in insects, it is generally white; even in the human body, it is not essentially red; the fibres of the iris, and the muscular coats of the arteries, the muscles of the stomach, of the intestines, and of the urinary bladder, are colourless. We cannot therefore define a muscle by that property which it often wants; but we may, with the utmost propriety, characterize it by its *contractile power*, the only true evidence of its nature; for the contraction of the iris proves it to be a muscle by truer marks than its colour; and by the same rule the muscles of a fish, or of the meanest insect, are as perfect as those of man.

* Such is the connexion betwixt muscles and their *contractile force*, or PRINCIPLE of IR-RITABILITY, that the moment it dies, all its astonishing power is gone: and the muscle which could lift an hundred pounds while *alive*, can bear the weight *but of a few pounds when *dead*.

Whereas,

The Plantaris Muscle



Whereas, on the contrary, all those parts that are *irritable*, as the ligaments, tendons, &c. are capable of bearing the same weight when *dead* as when *alive*.

This *irritable*, or *contractile power*, in muscles, is that property by which muscles recede from certain stimuli, without any feeling, without creating any consciousness of action, and so little dependant upon nerves, that it is found equally perfect in *animals* * and *plants* which have no nerves, and remains in parts severed from the body to which they belong. This *irritability* is so far independent of nerves, and so little connected with feeling, which is the province of the nerves, that upon stimulating any muscle by touching it with a caustic, or irritating it with a sharp point, or driving the electric spark through it, the muscle instantly contracts: although the nerve of that muscle be tied, although the nerve be cut so as to separate the muscle entirely from all connection with the system; although the muscle itself be separated from the body; although the creature upon which it be performed, may have lost all sense of feeling, and have been long to all appearance dead. Thus a muscle cut from the limb, trembles and palpitates long after the part, separated from the body, contracts when irritated, the *bowels*, when torn

* The polypus, according to John Hunter, is devoid of nerves.

from the body, continue their peristaltic motion, so as to roll upon the table, ceasing to answer to stimuli only when they themselves become actually dead. Even in *vegetables*, as in the sensitive plant, this contractile power lives. It is by this *irritable principle*, that a cut *muscle* contracts and leaves a gap; that a cut *artery* shrinks and retires into the flesh. Even when the body is dead to all appearance, and the nervous power gone, this contractile power remains; so that if a body be placed in certain attitudes, before it be cold, its *muscles* will contract, and it will be stiffened in that posture till the organization yields, and begins to be dissolved. Hence comes the distinction betwixt the *irritability* of the muscles and the *sensibility* of nerves; for the *irritability* of muscles survives the animal,—as when it is active after death;—survives the life of the part, or the feeling of the whole system, as in palsy, where the vital motions continue entire and perfect;—and where the muscles, though not obedient to the will, are subject to irregular and violent action;—and it survives the connexion with the rest of the system, as where animals very tenacious of life are cut into pieces: whereas *sensibility*, the property of the nerves, gives the various modifications of sense, as vision, hearing, and the rest; gives also the general sense of pleasure or pain; and thus the eye feels, and the skin feels; but their appointed stimuli produce

produce *no motions* in these parts ; they are *sensible* but not *irritable*. The *heart*, the *intestines*, and all the *muscles* of voluntary motion, answer to stimuli with a quick and forcible contraction ; and yet they hardly feel the stimuli by which these contractions are produced, or at least they do not convey that feeling * to the brain. There is no consciousness of present stimulus in those parts which are called into action by the impulse of the nerves, and at the command of the will : so that *muscular parts* have *all the irritability* of the system, with but *little feeling*, and that little owing to the nerves which enter their substance ; while *nerves* have *all the sensibility* of the system, but *no motion*.

The nervous influence is a mere stimulus to the voluntary muscles, as blood is to the heart and arteries ; food to the stomach ; or bile to the intestines. It loses its influence over the system sooner, than the irritable principle in the fibre fails : for the irritable state of the muscle continues long after the voluntary motion, or power of excitement from the nerves, is gone ; for when we die *slowly*, the irritable principle of the muscles is exhausted in the struggles of death. If, while in perfect health, we are killed by a *sudden blow*, the irritable power of the

* The cause of this curious phenomenon we shall particularly explain, when we come to treat of *ganglions*.

muscles survives the nervous system many hours or days, and the flesh trembles, and the absorbents continue to absorb; and often, as after suffocation, or drowning, we can, by operating upon this poor remains of life, restore the circulation, re-animate the nervous system, and recover that life, which seemed to have entirely left the body; and thus the nervous influence, which seemed to animate the system, and to be the prime mover and source of life, owes its restoration to that, which was conceived to be but a secondary power.

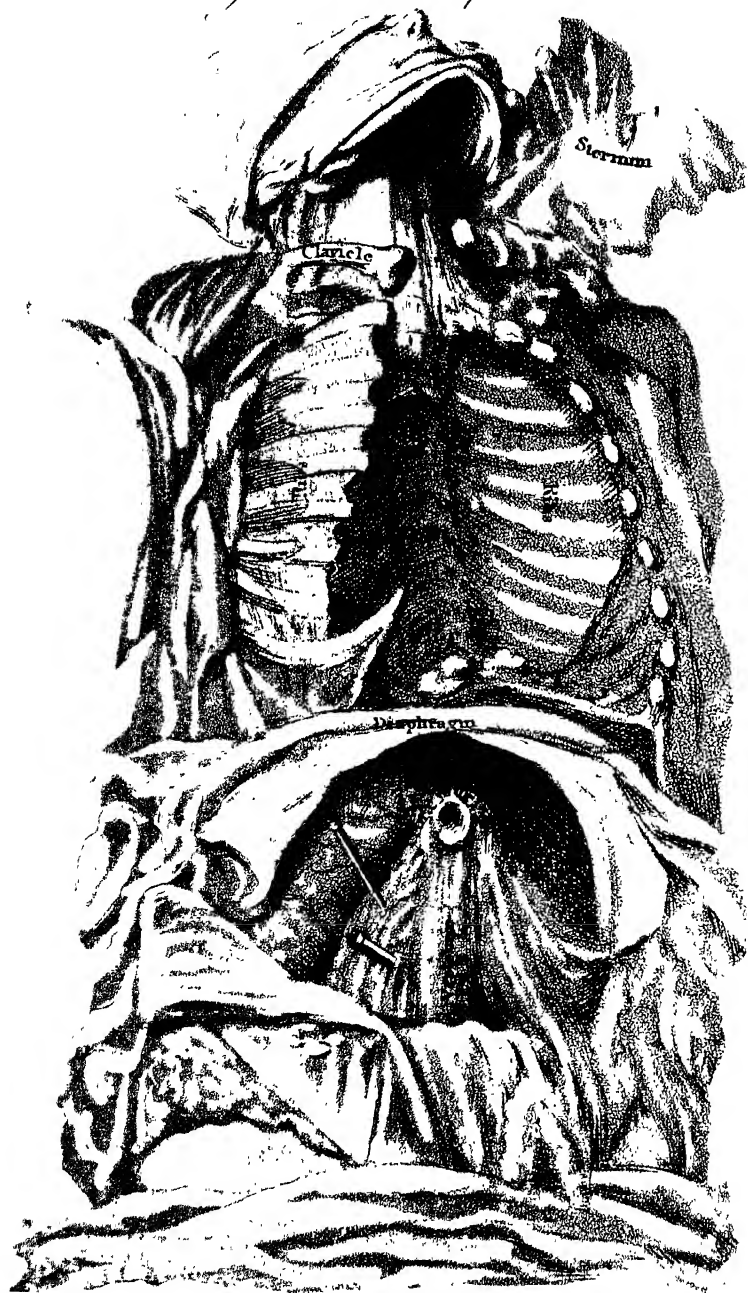
There are *some muscles* which have a *stronger contracting force* than *others*, and retain it a longer time after the animal is dead. The chief of these is the DIAPHRAGM*, which I have always observed

* The study of *anatomy*, as it leads to the knowledge of NATURE, needs not, says the illustrious Cheselden, many tedious descriptions, nor minute dissections; what is most worth knowing is soonest learned, and least subject to difficulties, while dividing and describing the parts, more than the knowledge of their uses requires, perplexes the learners, and makes the science tedious, dry, and difficult.

Upon this principle all the anatomical descriptions interspersed in this work will be conducted.

The *diaphragm*, or midriff, is a large broad muscle, that divides the *thorax* from the *abdomen*. In its natural state it is *concave* or vaulted above the *abdominal viscera*, and *convex* towards the *thoracic*. It is called, by Haller, "*Nobilissimus post cor musculus*," and, like it, is in constant action. At

The Body deprived of the viscera



observed to move a long while after the other, when the animal was dead, or at least, by irritating the *phrenic nerve* which goes to that muscle, it could be renewed. I have seen it, says Baron de Haller, irritable and tremble an hour or more after death, when the motion of the intestines had entirely ceased, and many others have witnessed the same along with me.

The **ŒSOPHAGUS***, when irritated, con- *The Œsophagus, or gullet.*
tracts.

the same time of inspiration, it is then a *plane*, and its motions are in general one fourth less than the heart. Besides being a muscle of inspiration; it assists in vomiting; and the expulsion of *fordees*; and it marks our passions by its irregular action, as sighing, yawning, coughing, laughing. It is affected by spasms, as in hiccup, lock-jaw, &c. It is both a muscle of voluntary and involuntary action, and the cause of its *involuntary action*, and its *general sympathy* with all the violent motions of the body, deserves a fuller attention of the philosophic anatomist than has been hitherto bestowed upon it. Some strong characters of special contrivance we cannot fail to observe here:

- 1st. The diaphragm separates posteriorly into *two slips*, betwixt which the *aorta descendens* passes.
- 2d. A little above this, and to the left side, in the most fleshy part of the diaphragm, there is a *direct opening* for the passage of the *œsophagus*, or gullet.
- 3d. There is also on the right side of the diaphragm a large triangular hole for the passage of the *vena cava ascendens*.

* The *œsophagus*, or gullet, is composed both of *longitudinal*, and *circular fibres*, but chiefly *circular*, abundantly more so than in the intestines; because this has no foreign
power

tracts itself very sensibly, and I have plainly seen its peristaltic motion after death, so that a morsel thrust into the œsophagus will be pushed upwards and downwards by the peristaltic motion excited by that stimulus.

The Stomach.

The STOMACH * is considerably *irritable*, and when touched with a corrosive, becomes immediately furrowed. If you irritate it with a knife, either at the *pylorus*, or elsewhere, it presently contracts itself; and when wounded the borders of the wound retract. You may see the motions of the stomach through the tendinous part of the *diaphragm* after it has been laid bare, as also shining through the *peritonæum* while the ab-

power to assist it, and because it is necessary the food should make a shorter stay here than there. Hence it is that horses drink against the law of gravity. The inner surface is a smooth membrane, abundantly supplied with *mucilage*, to sheath this organ, and render the passage of the aliment easy.

* *The stomach* is situated on the *left side* below the short ribs. The *right side* of the stomach is covered by the thin edge of the left lobe of the *liver*; the left presses on the *spleen*. Its figure nearly resembles the pouch of a bagpipe, its *upper side* being concave, and the *lower* convex, and its *left end* most capacious. The entrance into the *œsophagus* on the left side is called the *cardia*; on the right, where the chyme passes into the *duodenum*, is named *pylorus*, where there is a *circular valve*, or *sphincter muscle*, which hinders a regurgitation of the aliment. The stomach has *circular* and *longitudinal fibres*, and its *inner membrane* is bedewed with a strong and viscid mucus.

domen

17 THE INTESTINAL TUBE, OR PRIMA VIEL.



domen is entire. We therefore cannot doubt an instant of this organ being *irritable*.

The INTESTINES *, both *large* and *small*, *The Intestines.* are extremely *irritable*. When the intestine is only

The *intestinal canal* is usually five times the length of the individual. It is curiously convoluted in the abdomen. This space anatomists have thought fit to divide into 6 portions.

- 1st. The *duodenum*, because it is commonly reckoned in adults to be 12 inches long. At a small distance from where the stomach joins it, the *common gall duct* and the *pancreatic duct* open into it, from the one it receives the *bile*, and from the other the *pancreatic juice*.
- 2d. The *jejunum*, from its being in general found *empty*, on account of the fluidity of the chyme, the stimulus of this, and the bile, and the prodigious number of lacteals.
- 3d. The *ileum*, because of its situation near the pelvis, where the bones projecting like the wings of a phaeton are called *Ilea*.
- 4th. The *colon*, which takes an arched direction.
- 5th. The *cæcum*, or *blind gut*, a pouch, as it were, of the colon, about 3 inches long, and called *blum* from its being out of the direction of the passage of the food. Its diameter is twice as large as that of the other intestines. It has an *appendix*, called *vermiform*, whose use is not well ascertained, which floats loose in the abdomen, and in the mackerel there may be seen above 150 of them.
- 6th. The *rectum*, or *straight gut*, is the last, and at its termination is surrounded by *circular muscular fibres*, called the *sphincter ani*.

only slightly cut, the wound equally *retracts* its edges; but if cut quite through, these *curl* themselves *back*, so as to embrace the parts above, or, in other words, they turn inside out. When a part of the intestine only is irritated, it contracts so strongly there, that the cavity is quite closed, and the contents are pushed into the neighbouring parts, either upwards or downwards, which dilate, and soon afterwards, being irritated by their contents, they contract, and push along

The *three* first are termed the *small guts*, the *three* last the *great*. In the *small guts* there are numerous *plaits* to detain the food, and allow a wider surface for its absorption. These are larger, and far more numerous near the stomach, where the food is thinner, than they are towards the colon. At the entrance of the *ileum* into the *colon*, there are two *very large valves*, which prevent the regress of the *feces* into the *ileum*. The *cæcum* and *colon*, besides having stronger muscular coats than the small intestines, are furnished with three *ligamentous bands*, running lengthwise on their outside, dividing their surface into three portions nearly equal. Though these appear like ligaments externally, they are made up in their inner structure of true muscular fibres. The ligament-like bands, which in the *cæcum* and *colon* are collected into *three* portions, are spread *equally* over the surface of the *rectum*; a wise precaution of nature, that no part of it may be weaker than another, lest it should give way in the efforts of egestion. The *plaits* are considerably fewer in the *great guts*. They have *all* an *inner membrane*, studded with an infinite number of arteries, or glands, which pour out a lubricating fluid. They have *muscular fibres*, both *circular* and *longitudinal*.

whatever is contained. Very often, after the motions of the intestines have ceased, they are renewed again, and increased by little and little, by some *obscure cause* which restores the *irritability*. After they have been taken out of the body, I have observed, continues Baron de Haller, *this motion* rather to *increase*. They may be irritated *externally* either with a knife, a needle, alcohol, or corrosives, but their *internal surface* is much more irritable.

The GALL-DUCT *, and the *other excretory ducts*, are *irritable*; that is, stimuli produce no motion in them. *The Ductus Communis Coledochus.*

The ARTERIES have been always supposed to be *irritable*. This idea is countenanced, *first*, by seeing that the silk-worm has no heart, but only a large artery, which performs the office of a heart. *Secondly*, by the blood after death being expelled, whence these derive their name†; and *lastly*, by the motion of the fluids continuing, as may be seen in a microscope, even when the heart has been removed. Unless this was the case, the *pulse* of the arteries, which resembles the systole and diastole of the heart, will be very difficult to be accounted for. *The Arteries.*

* Or *common duct* of the *liver* and *gall-bladder*, which enters the *duodenum*† opposite the *pancreatic duct*.

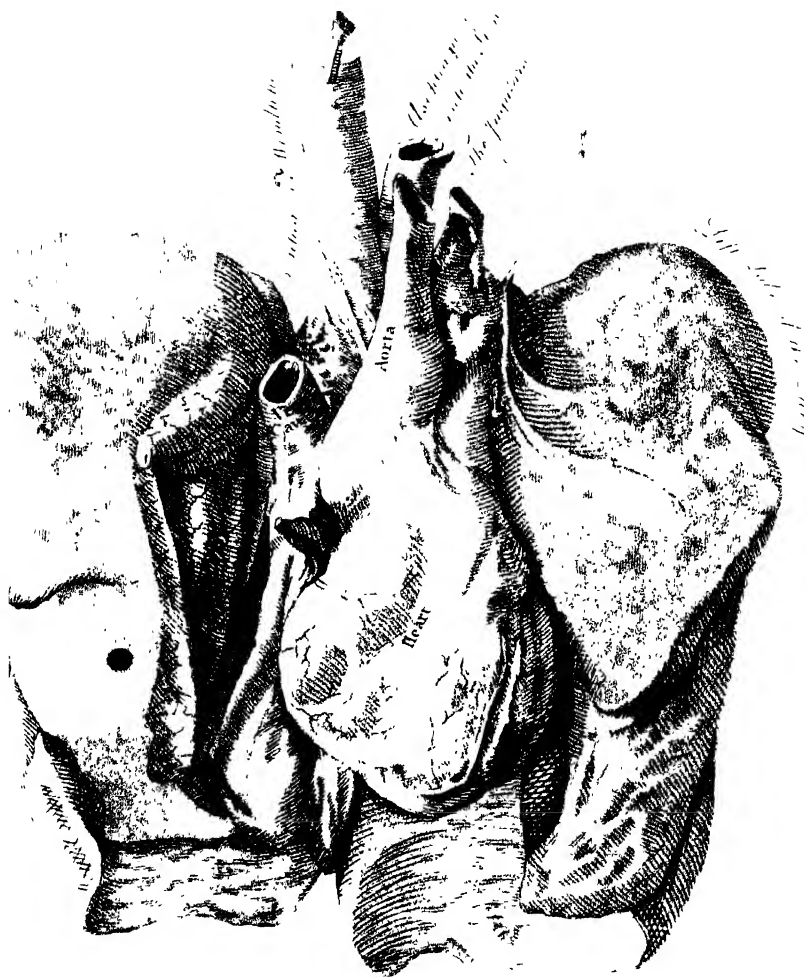
† *Arteries*, from *αἴρ*, air; and *τράω*, to draw.

The **LACTEALS** * contract and empty themselves like the *arteries*, upon being touched with *vitæ oleum*, and there is the same argument for their being *irritable* as for the *arteries*, viz. though they be ever so full of chyle at the time when the animal dies, they empty themselves, and contract in such a manner, that you cannot discover any fluid within them in the *dead animal*.

When making a puncture with a knife, into the **BLADDER** † of a dog just dead, it will *contract* itself, and force out its contents through the opening made in the abdomen.

* Called so from their containing *chyle*, which has the appearance of milk. The *lacteals* are vessels of absorption of infinite smallness, situated in the intestines. They increase in size, and terminate in a gland, called, the *mesentericum chyli*, whence this fluid proceeds along the *thoracic duct*, which terminates in the left *subclavian vein*. The *number* of the vessels of absorption are innumerable.

† For the anatomical description of this organ, vide page 80.



II. OF IRRITABLE PARTS.

The LUNGS * appear devoid of irritability.

The

* The lungs are situated on the right and left side of the heart. They are divided into two lobes, and these are subdivided into lobules, three on the right side and two on the left. The trachea, or wind-pipe, descends into the lungs, and forms innumerable cells, which have communication with each other, and give to this vessel a honey-combed appearance. In the membranes of these cells are distributed the branches of the two pulmonary arteries, and the returning vessels, or pulmonary veins. "I have," says the great Cheselden, "been in these cells, the AIR enters the blood-vessels, and mixes with the blood; but this opinion, however probable, wants sufficient experiments, to prove it; air being found in the blood, as it certainly is, is no proof of its entering that way, because it may enter with the water." "I think," says he, "the most probable argument for the air entering into the blood by the lungs, or rather from the lungs, is, that some of the air, may be fetched from the known experiment of each man in a diving bell wanting near a gallon of fresh air in a minute; for if profane divers were wanting, they often descend until the pressure of the air is three or four times what it is on the surface of the earth. Dr. Boerhaave observes, that the water vessels are very numerous, consisting of larger vessels, deep in land animals, and conjectures that this probably is the reason, why they bear to be longer, without breathing, as they are provided with a larger quantity of that JE NE SCAI QUOI from the air, which is so necessary to life." We shall throughout this work trace, as far as possible, the

*Liver, Kid-
ney, and
Spleen.*

The LIVER *, KIDNIES †, and SPLEEN ‡, have also *no irritability*; that is, they

true relation we stand in with respect to the external air, as upon the discovery of the true nature of the air, the great mystery of the office of the lungs and chylication is unfolded, and other matters of the utmost importance in the theory and practice of physic.

* The *liver* is the largest gland in the body, of a dusky red colour, immediately situated under the vaulted cavity of the *diaphragm*, or midriff, chiefly on the *right side*, and somewhat on the *left* above the *stomach*. Exteriorly, or anteriorly, it is *convex*, inwardly it is *concave*; very thick in its superior part, and thin in its inferior. The upper side adheres to the *diaphragm*, and it is fixed to this, and the *sternum*, or breast bone, by a broad ligament, called *suspensorium*. It is also tied to the navel by a ligamentous band, called *teres*, which is the umbilical vein of the foetal state degenerated into a ligament. Both these bands serve to suspend it, while lying on the back, from

ring too much on the subjacent *cava*, or otherwise it might press on this important returning vessel, stop the circulation, and put a period to life. Dogs and cats, and other animals, who are designed for leaping, have their liver divided into many distinct lobules which prevent a too great concussion of this viscus. Ours is divided into *two lobes*, of which the right is considerably the largest.

† The *kidnies* are two oval bodies, situated in the loins, contiguous to the two last short ribs; the *right* under the *liver*, and the *left* under the *spleen*.

‡ The *spleen* is situated immediately under the *diaphragm*, above the *left kidney*, and between the *stomach* and *ribs*. In figure it resembles a depressed oval, near twice as long as broad, and almost twice as broad as thick. It has

been

*Map of the Internal Abdominal Viscera, the External or Bowels
being removed*

they do not retract the edges of a wound made in them as do the muscles, or when irritated shew the least motion.

If you irritate a NERVE *, the muscle to *The Nerves.* which it is distributed is immediately *convulsed*; that is, it contracts its fibres, but in this experiment there will not be found the *smallest contraction* of the nerve.

I applied a mathematical instrument, says Baron de Haller, marked with very small divisions, lengthways, to a long nerve of a living dog, in such a manner that I was certain to perceive the *slightest contraction*, but upon irritating the nerve *no contraction* whatever could be perceived.

been taken from dogs, says Cheselden, without any marked inconvenience to them. Its office is the late discovery of the celebrated lecturer on physiology, Dr. Haighton.

* *Nerves* are white, firm, solid cords, which arise from the *cerebrum*, *cerebellum*, and *spinal marrow*, and are spread over every sentient portion of the body by innumerable filaments. *Ten* pair of nerves issue from the brain itself, and *thirty* from the spinal marrow. Those that go to the organs of sense are considerably larger than the rest, and are in part divested of their outer covering or external tunic.

III. OF SENSIBLE PARTS.

To point out what parts were *sensible*, we have the following experiments.

The
brain
belonging
Medulla
Oblongata.

Upon touching the BRAIN * with a knife, or in whatever way Baron de Haller did it, or upon applying any caustic body, the animal was seized with violent convulsions, and contorted his body on the one side or the other in the form of a bow, expressing by its screams violent anguish.

The Spinal
Marrow.

Having thrust a probe, says Dr. J. Johnson, into the SPINAL MARROW †, all the muscles of the limbs were violently convulsed.—The muscles of the back were so convulsed that the animal was bent backwards as in opisthotonos of the lock-jaw. The intercostal muscles were all contracted, and their natural action, that of drawing all the ribs nearer each other and upwards, was rendered a matter of ocular demon-

* The *brain* is divided into two portions; that situated in the upper part of the skull, is called *cerebrum*, and that in the hind part, under the former, *cerebellum*. On the external surface of the brain we see several inequalities, or windings, like the circumvolutions of the intestines, and the *cerebrum* divides into *two hemispheres*, while the *cerebellum* sends out an *oblong projection*, which passes through the large hole of the occiput, called *medulla oblongata*.

† The *medulla spinalis*, or spinal marrow, is a continuation of the *medulla oblongata*.

stration.



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stration. The diaphragm was also strongly contracted.

The NERVES *, which derive their source from the brain, are themselves extremely sensible. It is impossible to represent to one's self, without having seen it, the vast pain and disquietude which an animal is thrown into upon touching, irritating, or even tying a nerve.

The SKIN †, as being abundantly supplied with

* The nerves have been before described.

† When a blister has been applied to the skin of a negro, if it has not been very stimulating, in twelve hours after a bladder is formed, which is the *cuticle* or *scarf skin*. When this fluid and skin is removed, the surface underneath appears black; but if the blister had been very stimulating, the membrane in which this colour resides would have been raised with the cuticle. This is called the *rete mucosum*, which is itself a double membrane, containing a peculiar mucus, which gives the colour to the skin.

Malpighi first discovered this double membrane in the tongue, and transferred it to the skin covering the body. The scarf-skin or cuticle, is colourless, and the difference in the complexion of people entirely depends upon the mucus of the *rete mucosum*, being black in the negro, copper colour in the mulatto, brown in the Egyptian, and white in the Albino, as in the inhabitants of cold climates. With us it becomes brown in those exposed to the beams of the sun, and doubly so when reflected from the surface of the water, as in sea voyages, or from the white sands, as in Africa. The colour of this mucus is transmitted from parents to their children, but is capable of great modifications: the changing of a black man by repeated intemperance

with nerves, is found to be extremely sensible, for in whatever manner you irritate it, the animal makes a noise, struggles, and gives all the indications of pain that it is capable of.

The INTERNAL MEMBRANES of the STOMACH*, INTESTINES, BLADDER†.

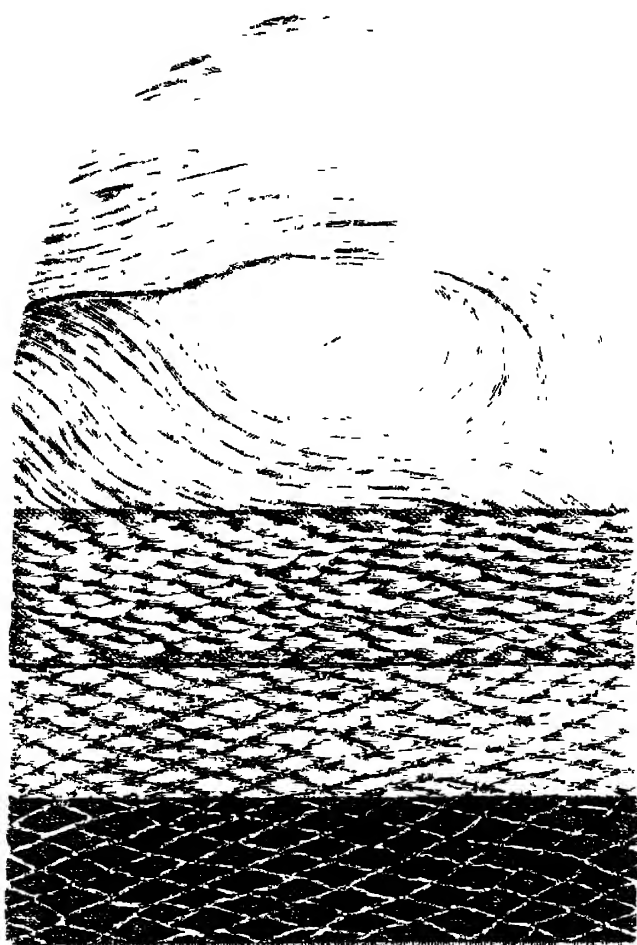
riages with white women, will in the fourth generation become perfectly white; and the converse of this is equally true.

Immediately under the internal layer of the rete mucosum, Mr. Cruikshank discovered a *third lamina* by injecting the skin of a person who had died of the small-pox upon which are situated the pustules of this disease. Some have supposed that this was only a formation of coagulable lymph between the two mentioned membranes, and the true skin. We take care to what is called the *cutis vera* or *true skin*, which is always white in people of whatever complexion they be. It is exceedingly vascular, and endowed with exquisite sensibility. It is extremely elastic stretching as in drapery, many feet, and after tapping, running nearly to its natural dimensions. It is thickest about the umbilicus, by which it bears weight or pressure and is thinnest about the neck and the back, the soles of the feet and palms of the hands. It is thinner the further it is from the centre of the arms and legs, and is thicker than the opposite surfaces. The lining is extremely thin, thus to allow the colour of

* This part has been described.

† The bladder is situated in the lower part of the belly, immediately below the umbilicus of the pubic bones, and above the rectum, or straight gut. It is the reservoir of

St. Mary of the
H. Council



and URETERS *, being of nearly the same nature with the skin †, does in consequence enjoy the same sensibility.

The MUSCULAR FLESH is sensible of *The Muscles* pain, which is dependant entirely on the nerves. For if you tie the nerve going to any part, that part becomes immediately *paralytic* below the ligature and *insensible*. Its vital functions however remain. A blister applied to the part below the incised nerve inflames and draws up the

the urine or aqueous part of the blood secreted by the kidneys, and sent from thence by its ducts, or *ureters*; its external passage is called *urethra*, the neck of which, or, more properly speaking, the bladder, is secured by a *circular muscle* called *sphincter urinæ*, the fibres of which close this opening, except under the great irritation of distention, or from the commands of the will. The coats, or tunics, of the bladder are the same as those of the intestines, stomach, and œsophagus, viz. an *internal* membranous, sensible, and secreting mucus, a *middle* muscular, and an *external* also membranous, but insensible.

* The *ureters* are tubes, about the size of goose quills, and about a foot long; they arise from the kidneys, and enter the bladder near its neck, running for the space of an inch *obliquely* between its coats, they form to themselves as it were valves, so that upon the contraction of the bladder, the urine is darted along the *urethra*, which is its proper passage.

† These several parts *differ* anatomically from the skin in this. They have no *cuticle*, nor *rete mucosum*, though they secrete a fluid analogous to this. They *differ* from the skin also in having *muscular fibres* immediately under them.

outer

outer skin, though it does not create pain ; ulcers are healed, and suppurate, and the limb seems to have lost nothing but the power of motion.

The Breast.

The Mammæ, or BREASTS *, as being covered with a good deal of skin, and furnished with many nerves, has also a proportionable degree of sensibility.

IV. OF INSENSIBLE PARTS.

In order to discover what parts were *insensible*, Baron de Haller made the following experiments.

The Dura Mater.

The DURA MATER † is a kind of periosteum, every where applied to the internal surface of the cranium, connected to it by vessels, and has arteries transmitted through it to the skull, in the same manner as they are transmit-

* Each *breast* is a *conglomerate gland*, or an assemblage of glands to separate milk, with their *excretory ducts*, which are capable of much distention, tending towards the nipple, and as they approach, unite, so as to make but a few ducts at their exit.

† The *dura mater* is a very compact strong membrane lining the inside of the skull, firmly adhering at its basis, and but lightly at the upper part, except at the sutures. It extends itself across the skull, so as to divide the *cerebrum* into *two hemispheres*. This part of the membrane is called the *falx*, and prevents in great measure the concussion of this part. It again projects laterally, and sustains the posterior part of the *cerebrum*, which hinders it from compressing the *cerebellum*.

ted through the periosteum to the other bones of the body. It is composed, like all the other membranes of the body, of cellular substance, and like them is perfectly *insensible*, so that it may be burnt with vitriol, cut with a knife, or tore with a pair of pincers, without the animal, the object of the experiment, appearing to suffer the least pain.

The brain naturally divides into two parts. The upper portion is called the *cerebrum*, and the smaller and lower portion the *cerebellum*. These are sheathed by a membranous covering called the PIA MATER *. Having removed, says Baron de Haller, a portion of the skull, with the *dura mater* contiguous to it, I touched it with butter of antimony, whereupon it was burnt to a scar, without the animal complaining in the least, or making any sort of struggling, or being at all convulsed.

The Pia Mater.

The insensibility of the PERIOSTEUM † was long ago observed by Mr. Cheselden, nor are we at all surpris'd at this, seeing there are no nerves distributed to it. I have torn and burnt the *periosteum*, without the animal's shewing the least sign of pain; nay young kids have suck'd during the experiment: whereas when pinched they have shewn the most evident marks of pain.

The Periosteum.

* This is an exceeding fine *membrane*, which invests the brain even between its folds, hemispheres, &c.

† A smooth *membrane* covering the bones.

That

The Peritoneum.

That the PERITONÆUM* is *insensible* I proved by repeated experiments, which I carefully made, after I had dissected away the *recti muscles*, which cover this membrane.

The Pleura.

I next made my experiment on the PLEURA †, having freed it from the *intercostal muscles*, which we know are well supplied with *nerves* (the

* Below the diaphragm, or midrif, under the muscles of the belly, lies that membranous expansion called the *peritoneum*, which is a much stronger covering than the pleura, and confines the intestines and contents of the abdomen.

† Every distinct part of the body is covered, and every cavity is lined, with a single *membrane*, whose thickness and strength is as the bulk of the part it belongs to, and as the friction to which it is naturally exposed. Those membranes, which contain distinct parts, keep the parts they contain together, and render their surfaces smooth, and less subject to be lacerated by the actions of the body: and those which line cavities, serve to render the cavities smooth and fit for the parts they contain to move against. The membranes of all the cavities that contain solid parts, are studded with glands, or are provided with vessels, which separate a *mucus* to make the parts contained move glibly against one another, and not adhere together. The *pleura* lines the whole cavity of the chest, where the heart and lungs are placed, and gives it that smooth and glossy appearance, which when these organs are removed we cannot fail to observe. It meets as it were on the breast-bone, on each side, and then becoming more compact, separates, and extending so as to form an acute triangle, it *divides* the two great lobes of the lungs, and is here called *mediastinum*. It then passes towards the vertebrae of the back, where it assumes again the name of *pleura*.

experiment

experiment was difficult, but I have frequently, done it, and most successfully on a kid, it being a very quiet animal), and even upon the PERICARDIUM *, in all which cases the membranes being cut or irritated, occasioned no sense of pain, nor the least change in the animal.

The Pericardium.

The celebrated Storch, as appears by the journal of the disease of which he died, was not sensible of any pain, while, in performing the paracentesis, the trocar pierced the *peritonæum*. Upon this occasion I foresee that many eminent physicians, who place the seat of head-ach and phrenites in the *membranes* of the brain, and the violent pain of the pleurisy in the membrane of the *pleura*, will differ from me in opinion. But I only relate facts, and as a searcher after truth, it is immaterial to me on which side nature decides the question. Neither are these truths altogether repugnant to pathology. Boerhaave affirmed long ago, that in inspiration, the *pleura* of the ribs was less upon the stretch, because the ribs by means of the intercostal muscles approached nearer each other, and on the contrary, in expiration, *this membrane* was more *tense* because the

* The *pericardium*, or heart purse, is an exceeding strong membrane, which covers the heart, even to its basis. Its uses are to keep the heart from having any friction with the lungs; and to contain a fluid to lubricate its surface. It is firmly fastened to the great vessels that enter into, and issue from, the heart; as also to the diaphragm.

ribs

ribs receded to a greater distance from each other. But in *pleurisy* the patient suffers most in *inspiration*; that is, when the *pleura* is *least distended*, and *vice versa*; wherefore that great man did not place the seat of this disease wholly in the *pleura*, but he joined it with an inflammation of the *intercostal muscles*, which serve to bring the ribs nearer together, and which we have before proved to be a sensible part.

I am much disposed, says the present celebrated professor of physic at Ebinburgh, Dr. Monro, to join with those who think that we mistake the true seat of the pain in *pleurisy*. I caused, says he, the operation for emphysema to be performed three times, and I was particularly attentive to this question. I scratched and tore the *pleura*, yet the patient did not make any remarkable complaint, and I would have concluded so, from this plain consideration, what is the use of the *pleura*? It is a mere soft lining to obviate the evil of friction, and I could not imagine that *nature* would have formed this acutely sensible. I crooked a probe, and turning the point against the *pleura*, I pricked it rudely, and the patient just felt that I was pressing him, but experienced no pain. In one case I caused the side to be perforated, and introduced a bougie *ten inches*, and turning it round, the patient felt something moving, but no pain. I repeated this some days after the operation, when an inflammation was
come

come on, and still with the same effect. I have repeated the experiments of Haller on quadrupeds, cutting away the intercostal muscles, and have torn away the *pleura* without the animal seeming to complain.

If the dura and pia mater, and likewise the periosteum, and the peritonæum, and pleura, be found void of sensation, there is little expectation that other membranes should possess a different characteristic property; and indeed the MEDIASTINUM and OMENTUM* are mere

*The Medi-
astinum and
Omentum.*

* The *omentum* or cawl, in Greek *ἐπιπλόον*, is a broad, thin, and transparent membrane, arising from the inferior and interior border of the stomach, and reaching down as far as the navel; then doubling backwards and upwards, is connected with the colon. Besides its principal connections with the stomach and colon, it is likewise attached to the duodenum, to the spleen, pancreas, and *mesentery*, which is a membrane fastened to the intestines, along which the *lacteals* run. The omentum lies immediately under the peritonæum. It is every where a double membrane; I speak not of its great fold already mentioned; but every portion of the thin membrane, by itself, may be divided into two thinner membranes which are joined together by cellular texture, in the cells of which the fat is deposited. The secretion here is performed in the most simple manner, like secretions in plants, there being no glandular apparatus. The fat is distributed very unequally in the omentum, as you may find it in some places very thin and transparent, and in other places above an inch thick. The omentum, or cawl, in calves, gives a very beautiful representation of this fact. The use of the omentum are first

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*The Cellular
Membrane.*

mere reflections of *pleura*. All these membranes being destitute of nerves, are of the same nature as the **CELLULAR MEMBRANE** *, and are therefore insensible to stimuli.

There

to interpose between the *peritonæum*, the intestines, and the stomach, to keep all these parts moist, warm, slippery, and to hinder their adhesion; but most probably its chief use is to furnish *oil* to the liver to be converted into *bile*, which is chiefly composed of *alkali* (azot and hydrogen) and *oil* (hydrogen and oxygen). For the fat, though it is deposited in the cells of the omentum, yet must it have some kind of circulation; otherwise its store would be continually augmenting beyond measure; and as there are here no other excretory ducts but veins, and these all terminate in the *vena portarum*, which vessel goes to the liver, carrying to its excretory vessels that fluid, from whence in part *bile* is generated; and hence it is a reservoir for the formation of the bile, as the spleen is for the formation of the pancreatic juice.

* The *cellular texture* is continued without interruption all over the body, and is insinuated into every recess. It is composed, not of fibres laid together or interwoven, nor of small tubes, or vessels, though they run along it, being only adventitious, and no part of its true structure, but of unorganized *lamellæ*, like fine scales. The lamellæ receding from one another, which partly again uniting transversely, form cells, in such a manner as to communicate together all over from head to foot. If we conceive a sponge, in which every cell opens into all those that are contiguous to it, we shall form a just idea of the cellular texture. Its cells are in some places smaller, in others larger; it is dilatable by a very small force, where it is not confined by the resistance of neighbouring parts. Where its cells are largest, and its texture looser, it contains fat, as immediately under

There is no doubt of the CUTICLE, or *The Cuticle.* scarfskin, being insensible, seeing you may cut it, as with corns, which is only an increased cuticle, or burn it with nitrous acid, until you give it a durable taint, without occasioning the least pain.

THIS GLUTEN, which divides the cuticle *The Rete Mucofum.* from the cutis vera, or true skin, as it cannot

det the skin, almost over all the surface of the body, between it and the most external muscles; in the intervals, or interstices, between one muscle and another; in the omentum, around the kidneys, &c. This membrane, web, or texture, by laborious dissection, by blowing air into it, by injections, by maceration, hath been found to follow every visible bundle of muscular fibres, every tendon, every vessel, even every the minute nerve. We shall find it constituting a great part of the œsophagus, stomach, intestines, urinary bladder, &c. So that there is no physical joint in the whole animal fabric, in which there is not a portion of the cellular texture. Its use and importance in the animal body is very great. It serves as a bond of union by tying and fastening all the parts together, yet in such a manner, as not to prevent or obstruct their necessary motions. to contain fat, if required; or marrow; or serum; or a thin vapour; to render parts smooth, and moist, and flexible; and to hinder them from growing together. It yields a commodious way or road for vessels and nerves to glide along. It furnishes a considerable part of the linings of the great cavities of the body, and immediately covers and envelops each particular viscus of the body; inasmuch that *Haller*, who, of all anatomists, hath most minutely examined, and most fully and extensively considered it, declares, "that for certain the fat greater part of the animal body is composed of it."

easily be separated from the cuticle, it became impossible to try experiments upon it; but one may reasonably suppose, like *other fluids*, it has no feeling.

The Fat The FAT is a fluid contained within the cellular membrane. That this fluid may be pierced without inflicting pain, may be seen by a needle thrust into the flesh of a hog, who will shew no signs of pain, until it has got quite through the fat and reached the flesh below.

The Tendons. The constant event of my experiments was, that the animal whose TENDON * was lacerated, burnt, or pricked, remained quiet, without shewing any signs of pain, and when part of the wounded tendon remained, it would walk without complaining. After I was fully satisfied of the event, I had no difficulty in discovering the cause, there being *no nerves* that I could trace to that part. Seeing therefore in the human body the nerves *only* are capable of sensation, it is neither unnatural nor improbable that the tendons being destitute of nerves should have no sensation. I have oftener than once seen the tendons laid bare in men, and emboldened by the experiments which I have made on brutes, I once laid hold, with a pair of forceps, of the naked tendon of the flexor, that bends the third

* *Tendons* are not condensed muscular fibres, but condensed cellular membranes attached to muscular fibres, for the convenience and beauty of this elegant part of our machinery

joint of the fore-finger, without the gentleman being in the least sensible of it. I have likewise seen the supinator longus chafed with hot oil of turpentine, in order to stop an hæmorrhage; it occasioned an acute pain in the skin, but the patient felt none in the tendon. Wherefore there is no need of fear from the accident of the ruptured tendon. I have seen a new cellular substance grow in a few days, and unite the *tendo achillis* that was cut through in a dog. As soon as the edges were united, the animal suffered no inconvenience, and jumped with the same agility upon the chairs as before.

When we cut open, says a very eminent physiologist*, a fascia or *tendinous membrane*, there is little pain: when, as in amputation, we cut the tendons even and neat, there is no pain: when we snip with our scissors the ragged *tendons* of a bruised finger to cut it off, the patient does not feel: and lastly, when we see *tendons* of suppurated fingers lying flat in their sheaths, we draw them out with our forceps, or touch them with probes, without exciting pain. Oil of vitriol has been poured upon each of the parts belonging to a joint, and a piece of caustic has been dropped into its cavity, but still no pain ensued; nay, some have been so bold, may I not say so vicious, as to repeat these experiments upon the human body,

* Mr. John Bell of Edinburgh.

pinching, pricking, and burning the *tendons* of the leg, and piercing them with knives, in a poor man, whose condition did not exempt him from this hard treatment; who was ignorant of this injustice that was done him, while his cure was protracted, and he was made a cruel spectacle for a whole city!

*Tr. Cap-
f
's / r Lig-
ment.*

In a cat I filled, says Baron de Haller, the articulation of the femur with the pelvis with vitriolic acid, without its seeming to feel this violent corrosive. Sometimes instead of caustics I have tried the knife, and have transpierced the CAPSULE of the knee, and the LIGAMENTS, and scraped the patella, without the animal shewing the least sign of pain. And indeed it is well ordered by nature, that those parts which are exposed to continued friction should be void of sensation*.

The Bones.

The insensibility of BONES is still disputed, and indeed I have made no experiments upon this subject, for in that cruel torture which is required to lay bare the bones it is nearly impossible to distinguish the two pains. In the large bones I never could find any nerve entering the

* In a state of health these parts are certainly *insensible*. In the state of disease are the neighbouring and sentient parts also in a state of disease, or whence the pain from *white swellings*, &c.? This subject deserves the most serious attention of the philosophic anatomist, and we shall again reconsider it when treating on diseases.

bone,

bone, and I have seen the operation of the trepan performed upon sound persons who had the free use of their senses, without their complaining of any increased pain during the perforation of the cranium *.

Several authors have affirmed the MARROW *The Marrow.* to be extremely sensible, but seeing no nerves enter the bones, and that it is of the same nature as fat, it appears highly improbable.

The sensibility of the TEETH † to heat and cold is wisely provided, that nothing might pass into the stomach that might irritate so important an organ. But otherwise they are insensible, being often scaled and filed without the person complaining in the least. *The Teeth.*

It is wisely ordained that the GUMS ‡ should *The Gums.* be insensible. Hence they serve, when the teeth are removed, the office of mastication, and are lanced or cut without the least sensation of pain.

* In the case of *nodes*, &c. are not the bones sensible?

† The *teeth* are of three kinds.

1. The *incisores*, or cutting-teeth, being made of the form of a chisel.
2. The *canini*, or dog-teeth, being pointed in the form of an awl.
3. The *molars*, or grinders, having a flat and uneven surface for the grinding of food, shaped like an anvil.

‡ In the state of *inflammation* they seem to have some sense of feeling, and *excite* a dull sensation of pain.

We have seen then there is a difference in the parts of the human body, according to the several *uses* for which they are designed; some are vascular and soft, others bony and hard: some sensible, and very prone to inflammation and disease; others callous and insensible, have little action in their natural state, and little proneness to disease.

The greater part of the body is merely insensible and inirritable matter, united into a moving and perfect whole. In some places there is such a conflux of nerves, as form the most delicate and perfect sense, endowing that part with the fullest life; while others are left without nerves, almost inanimate and dead, left feeling, where it ought not to be, should derange the whole system.

The living parts of the system are the muscles and nerves; the *muscles* to move the body, and perform its offices, each muscle * answering to its particular stimuli, and most of them obeying the commands of the will; the *nerves* to feel, to suffer, and to enjoy, to issue the commands of the will, bringing the muscles into action: but still the muscles have their own *peculiar life*, or *irritability*, superior to the nerves, and independent of them. It is a power which survives that of the

* Including the *hollow muscles*, as the heart, arteries, lymphatics, stomach, intestines, &c.

nerves, acting even when severed from the general system; and acting often on the living body, without the impulse of the nerves, and sometimes in opposition to the will.

The insensible and inirritable matter of the system joins these living parts, and performs for them every subservient office,—forms coverings for the brain ;—coats for the nerves ;—sheaths for the muscles ;—tendons,—ligaments,—and all the apparatus for the joints ; unites them into one whole by a continued tissue of cellular substance, which has no interruption, and suffers no change, but still preserves its own insensible nature, while it joins the sentient and moving parts to each other. The tendons, ligaments, periosteum, and capsules of joints, are all composed of this cellular substance, which by its *elasticity*, binds and connects the parts, and by its dead and insensible nature, is less exposed to disease, and appears therefore to be the fittest medium of connexion for the *living* system. To conclude,

Baron de Haller, therefore, properly calls that a SENSIBLE PART of the human body, which, upon being hurt, transmits the impression to the soul : or which, in other words, occasions evident signs of pain and disquiet in the animal. On the contrary, he calls that INSENSIBLE, which being burnt, tore, pricked, or cut till it is quite destroyed, occasions no sign of pain or convulsion, nor any sort of change in the situation of the

the body: and he calls that an IRRITABLE PART, which becomes shorter upon being touched; very irritable if it contracts upon a slight touch, and the contrary, if by a violent touch it contracts but little.

We have therefore a *threefold division* of the human body into PARTS,

1. SENSIBLE;
2. INSENSIBLE; and
3. IRRITABLE *.

As long as medical science was built, not upon the substantial basis of actual experiment, but imagined properties, assumed as data, it was changing every day its forms; for one fanciful opinion has always a right to supplant another. At length the sun of science arose, which dispelled those mists which obscured so sublime a science, who following the maxim of Bacon, wisely exclaimed, “Non fingendum aut excogi-

* It is with some reluctance that I present to the humane Reader this useful detail of experiments on animals, though I think a better apology may be given for these, than for the *diversions* of hunting, fishing, and shooting, which are universally tolerated in civilized societies:—and, perhaps, the compassionate Reader, like those who do not object to the enjoyment of the fruits of these sports and pastimes, as they are improperly called, so may he peruse with some pleasure the conclusions drawn from the sufferings of nature, inflicted by man on animals, from the more *exalted motive of philanthropy*,

“tandum,

“tandum, sed inveniendum quid natura faciat aut
 “ferat:” that the operations of nature were
 not to be fancied, but diligently scrutinized.
 Hence in the shortest space of time, the prin-
 ciple of philosophizing being altered, more light
 was thrown upon every branch of science than
 it had received for above two thousand years be-
 fore. He who laid the real foundation for the
 true science of medicine, was, as we have seen,
 the celebrated Haller. He was the son of an ^{*1 1/2 of Hal-*}
^{*ler.*} advocate of considerable eminence in his pro-
 fession. His father had a numerous family, and
 Albert was the youngest of five sons. From the
 first period of his education, he shewed a very
 great genius for literature of every kind: to for-
 ward the progress of his studies, his father took
 into his family a private tutor, named Abraham
 Billodz; and such was the discipline exerted by
 this pedagogue, that the accidental sight of him,
 at any future period of life, excited in Haller
 very great uneasiness, and renewed all his for-
 mer terrors. According to the accounts which
 are given us, the progress of Haller’s studies,
 at the earliest periods of life, was rapid almost
 beyond belief. When other children were be-
 ginning only to read, he was studying Bayle and
 Moreri; and at nine years of age he was able to
 translate Greek, and was beginning the study of
 Hebrew. Not long after this, however, the
 course of his education was somewhat interrupt-
 ed

ed by the death of his father; an event which happened when he was in the 13th year of his age. After this he was sent to the public school at Bern, where he exhibited many specimens of early and uncommon genius. He was distinguished for his knowledge in the Greek and Latin languages; but he was chiefly remarkable for his poetical genius: and his essays of this kind, which were published in the German language, were read and admired throughout the whole empire. In the 16th year of his age he began the study of medicine at Tubingen, under those eminent teachers Duvernoy and Camerarius; and continued there for the space of two years, when the great reputation of the justly celebrated Boerhaave drew him to Leyden. Nor was this distinguished teacher the only man from whose superior abilities he had there an opportunity of profiting. Ruysch was still alive, and Albinus was rising into fame. Animated by such examples, he spent all the day, and the greatest part of the night, in the most intense study; and the proficiency which he made, gained him universal esteem both from his teachers and fellow students. From Holland, in the year 1727, he came to England. Here, however, his stay was but short; and it was rather his intention to visit the illustrious men of that period, than to prosecute his studies at London. He formed connexions with some of the most eminent of them. He was

was honoured with the friendship of Douglas and Chefelden; and he met with a reception proportioned to his merit from Sir Hans Sloane, president of the Royal Society. After his visit to Britain, he went to France; and there, under those eminent masters, Winslow and Le Dran, with the latter of whom he resided during his stay in Paris, he had opportunities of prosecuting anatomy, which he had not before enjoyed. But the zeal of our young anatomist was greater than the prejudices of the people at that period, even in the enlightened city of Paris, could admit of. An information being lodged against him to the police for dissecting dead bodies, he was obliged to cut short his anatomical investigations by a precipitate retreat. Still, however, intent on the farther prosecution of this study, he went to Basil, where he became a pupil to the celebrated Bernoulli.

Thus improved and instructed by the lectures of the most distinguished teachers of that period, added to uncommon natural abilities, and unremitting industry, he returned to the place of his nativity in the 26th year of his age. Not long after, he offered himself a candidate, first for the office of physician to an hospital, and afterwards for a professorship. But neither the character which he had before he left his native country, nor the fame which he had acquired and supported while abroad, were sufficient to
 combat

combat the interest opposed to him. He was disappointed in both; and it was even with difficulty that he obtained, in the following year, the appointment of keeper of a public library at Bern. The exercise of this office was indeed by no means suited to his great abilities: but it was agreeable to him, as it afforded him an opportunity for that extensive reading by which he has been so justly distinguished. The neglect of his merit, which marked his first outset, neither diminished his ardour for medical pursuits, nor detracted from his reputation either at home or abroad: for soon after he was called to quit his country. George II. king of Great Britain, being desirous of promoting the prosperity of the university of Gottingen, invited M. de Haller, and established for him there an anatomical, botanical, and surgical professorship. The duties of this important office he discharged, with no less honour to himself than advantage to the public, during the space of 17 years; and it afforded him an ample field for the exertion of those great talents which he possessed.

The task of teaching a science, in all its parts, to a class of scholars at an university, should seem sufficient to employ the whole time which a society has a right to expect the most laborious man to sacrifice. The objects of medicine include the dearest interests of man, his health and existence. In this science, uncertainty is
never

never indifferent, and error always dangerous, in its consequences. The art is founded on an intimate knowledge of the organization of the human body, a structure, the harmony and proportions of which, though most wisely and accurately formed, are liable to be deranged by innumerable accidents. The means of restoring health are exceedingly multiplied, and the selection of remedies as delicate as important. To this science a variety of other knowledge is requisite; and each species opens an extensive field for inquiry. Every day produces new discoveries, which it is necessary a professor should not only be acquainted with, but examine and explain. Besides public lectures, private instructions are to be given to his pupils. The slothful are to be stimulated, the diligent encouraged; those who are slow of understanding to be more particularly and patiently informed; and those of brilliant and quick parts, restrained from deviating from the simple paths of nature, and wandering too far into the labyrinths of speculative hypothesis. To effect these purposes requires much time, labour, and application.

Notwithstanding these important employments, the seventeen years which M. Haller spent at Gottingen, were those, in which he executed his great works; and during this period, his superior literary reputation was acquired. The detail of all his researches, nay, the mere list of his writings,

ings, would exceed our present bounds; and it will be necessary to pass over several, which would have been highly ornamental and honourable to any other author, and to confine ourselves to those great works which must certainly immortalise the name of Haller.

He availed himself of his credit with the king of Great Britain to procure the most useful institutions for the university over which he presided. Amongst these was a school for surgery; an academy of sciences; a hospital for lying-in-women, in which the art of midwifery is taught; a collection of anatomical preparations; and a school for design, where the pupils were instructed to delineate with precision and truth all the objects of natural history. This last institution is hitherto the only one of its kind, whereas, academies of painting are very numerous.

He selected *physiology* as the principal object of his studies; a branch of medicine which, penetrating into the intimate structure of the various parts of the body, inquires into the laws by which man is formed, developed, grows, lives, decays, and dies; in what manner each organ performs its proper motions, and regulates the offices to which it is destined; by what means the organs, whose necessary functions continually tend to their own destruction, are capable of being repaired by nourishment and sleep; by what

what mechanism, a power, the principle of which is unknown to us, sometimes executes, at the command of the will, actions that are necessary to the preservation and prosperity of man, and at other times produces, independently of the will, operations which are essential to his existence. *Physiology* also investigates the mode in which the changes in these organs, at one time, are the cause, and at another, the effect, of disorders in the vital functions; what connexion exists between the alterations in these functions, and the diseases of the parts which execute them; and, lastly, in what manner remedies of every kind, by their action on these organs, possess the power of re-establishing order in the animal œconomy.

M. de Haller was not uninformed, that this Science, having been long devoted to the spirit of system, had become suspicious to *philosophical* physicians; but these objections were what he proposed to obviate. He entertained the hope of rendering *physiology* as certain as any other physical science: a science by which philosophers might learn the knowledge of nature, and where physicians might find a basis on which they might support their practice.

To this end, it was necessary to endeavour to establish *physiology* on an exact anatomy of man and of other animals; by the latter of which so many discoveries have been made concerning

the animal œconomy of our own species, which had not been revealed by the study of the human body. It was necessary to banish, from *physiology*, both that metaphysical jargon, which has long served, in all the sciences, to cover real ignorance under scientific words, and those theories, whether mathematical or chemical, which have been doubted even by mathematicians and chemists themselves; and are constantly made use of with so much more confidence, or adopted with greater respect, in proportion as the masters or scholars are more completely ignorant of the foundations on which they have been erected. It was necessary to substitute to all these systems, general *facts*, established by observation and experiment; to possess sagacity to lay hold of these facts; to try to ascertain their causes, and yet to acknowledge that, in all the sciences, there are bounds beyond which it is doubtful whether the human mind will ever be able to penetrate, but which it assuredly cannot pass, but by the assistance of time and a long course of labour, and often through accident.

Such was the plan which our professor had formed; and he pursued it with that activity and success, which he has exhibited in his other works, as an accurate and profound *natural philosopher*. He was so truly original in physiology, that, even in his life-time, his contemporaries and

rivals placed him in the first rank of writers on those subjects.

But it was not till after he had examined, in a numerous suite of memoirs, the important and difficult questions concerning respiration, the circulation of the blood, muscular motion, and the formation of the bones, that he thought himself qualified to comprehend *physiology* in its full extent: and even then his first edition bore the modest title of a mere *essay*. Nor was it till after thirty years of labour and immense researches, that he thought himself justified in bestowing on his work the title of, *Elementa Physiologia*. Extensively acquainted with the sentiments of others respecting the economy of the human body, struck with the diversity of opinions which they held, and sensible that the only means of investigating truth was by careful and candid experiment, he undertook the arduous task of exploring the phænomena of human nature from the original source. In these pursuits he was no less industrious than successful, and there was hardly any function of the body on which his experiments did not reflect either a new or a stronger light. In this work all the parts of the human body are described; we have there an opportunity of examining the opinions which have been recommended, or at least advanced by celebrated authors, who have attributed different uses to the same parts. M. de

Haller did not always decide between these opinions; sometimes he proved that they ought all to be rejected. Nothing of importance that had been previously published, escaped his observation, and he almost uniformly added remarks of his own to the intelligence he had obtained from books or conversation.

We shall not here enter into the immense detail of errors which Haller has destroyed in *physiology*; of new facts which he has added; of the ingenious and deep views which he has opened; of the doubts he has cleared up, or of the theories he has perfected or reformed: this would be to copy nearly the whole of his work. We shall confine ourselves chiefly to those subjects which relate chiefly to the object of this work, viz. *irritability*. It was not long necessary for him, in this arduous inquiry, to labour alone. The example of the preceptor inspired his pupils with the spirit of industrious exertion. Zinn, Zimmerman, Caldani, and many others, animated by a generous emulation, laboured with indefatigable industry to prosecute and to perfect the discoveries of their great master. And the mutual exertion of the teacher and his students, not only tended to forward the progress of medical science, but placed the philosophy of the human body on a more sure, and an almost entirely *new basis*. But the labours of Dr. Haller, during his residence at Gottingen, were by no means confined

ness to any one department of science. He was not more anxious to be an improver himself, than to instigate others to similar pursuits. Such distinguished merit could not fail to meet with a suitable reward from the sovereign under whose protection he then taught. The king of Great Britain not only honoured him with every mark of attention which he himself could bestow, but procured him also letters of nobility from the emperor. On the death of Dillenius, he had an offer of the professorship of Botany at Oxford; the states of Holland invited him to the chair of the younger Albinus; the king of Prussia was anxious that he should be the successor of Mau-pertuis at Berlin. Marshal Keith wrote to him in the name of his sovereign, offering him the chancellorship of the university of Halle, vacant by the death of the celebrated Wolff. Count Orlov invited him to Russia, in the name of his mistress the empress, offering him a distinguished place at St. Petersburg. The king of Sweden conferred on him an unsolicited honour, by raising him to the rank of knighthood of the order of the polar star; and the emperor of Germany did him the honour of a personal visit; during which he thought it no degradation of his character to pass some time with him in the most familiar conversation.

Thus honoured by sovereigns, revered by men

of literature, and esteemed by all Europe, he had it in his power to have held the highest rank in society. Yet, declining all the tempting offers which were made to him, he continued at Gottingen, anxiously endeavouring to extend the rising fame of that medical school. But after 17 years residence in that university, an ill state of health rendering him less fit for the duties of the important office which he held, he solicited and obtained permission from the regency of Hanover to return to his native city of Bern. His fellow-citizens, who might at first have fixed him among themselves, with no less honour than advantage to their city, were now as sensible as others of his superior merit. A pension was settled upon him for life, and he was nominated at different times to fill the most important offices in the state. These occupations, however, did not diminish his ardour for useful improvements. He was the first president, as well as the greatest promoter, of the Œconomical Society at Bern; and he may be considered as the father and founder of the Orphan Hospital of that city. Declining health, however, restrained his exertions in the more active scenes of life, and for many years he was confined entirely to his own house. Even this, however, could not put a period to his utility: for, with indefatigable industry, he continued his favourite employment
of

of writing till within a few days of his death; which happened in the 70th year of his age, on the 12th of December 1777.

The next person of eminence who stands forward as an improver of the science of medicine is the celebrated Dr. CULLEN. As a teacher he had peculiar merit. He always mingled the most agreeable eloquence with deep disquisition. From the moment he ascended the chair, he commanded the most respectful attention from his pupils, inasmuch that no student was ever observed to quit the theatre during the time he was lecturing. He was universally allowed to be an accurate anatomist, and a most ingenious physiologist. He enlarged the boundaries of chemistry, and has the honour of being the instructor of the illustrious Dr. Black. He was intimately acquainted with all the branches of natural philosophy, and had studied well every system of ancient and modern physic. He found that of Boerhaave universally adopted, when he accepted the chair in the university of Edinburgh. Dr. Cullen ably exposed the errors of this pathology, and paid considerable attention to the *nervous system*, as best explanatory of the nature of several diseases. *Life of Dr. Cullen.*

The brain, says he, seems by its constitution, to be disposed to the alternate states of *rest* and *activity*; as appears in the alternate states of sleep and waking, which constantly take place in every *His System.*

every animal; but wherein this constitution consists, it is difficult to discover.

The most common opinion is, that the *brain* is a secretory organ, which secretes a *fluid* necessary to the functions of the nervous system; that this fluid is *alternately exhausted* and *recruited*, and thereby gives occasion to the *alternate states* of *sleep* and *waking*. But this supposition is attended with many difficulties. The *nervous fluid* in the brain is truly capable of *different states* or *degrees of mobility*, which we shall call its states of EXCITEMENT and COLLAPSE; but without intending, by these terms, to express or determine any thing with regard to the nature of the *nervous fluid*, or wherein its different states consist.

This subject may be further illustrated, by observing, that the *excitement* of the brain appears to be in very different degrees on different occasions. It seems to be *greatest* in certain maniacs endued with uncommon strength, resisting the force of most impressions, and with the utmost difficulty admitting sleep.

A lesser degree of *excitement* occurs in the ordinary state of waking in health, when the excitement is total with respect to the functions of the brain, but readily admitting of sleep.

This excitement may be considered as of two kinds; either as it respects the vigour, or as it respects

respects the mobility of the system : and these different states of the brain are expressed in the body, by strength or debility, alacrity or sluggishness ; and in the mind, by courage or timidity, gaiety or sadness.

A degree of collapse takes place in the case of natural sleep, when the collapse prevails so far as to suspend very entirely the exercise of the animal functions ; and, though the exercise of the vital and natural continue, they are considerably weakened.

A partial collapse may take place in the brain, which discovers itself by the delirium which appears in a state that often occurs as intermediate between sleep and waking ; and even in sleep the collapse with respect to the animal functions, takes place more or less entirely ; whence the sleep is with or without dreaming, and the dreaming is more or less active.

A still greater degree of collapse takes place in the case of syncope ; in which it is so great, as to suspend the exercise of the vital functions concerned in the circulation of the blood, notwithstanding the force of habit in these, and their being exposed to constant stimuli. Here the collapse may be very considerable ; but there still remains some degree of excitement while the brain can be acted upon by stimuli, *which act only on vital powers*, and while its usual excitement is still recoverable by such stimuli.

If

If the *collapse* is *still more complete* and irrecoverable, it is the state of DEATH.

From what is now said of the *excitement* and *collapse* of the brain, it will appear, that we suppose LIFE, so far as it is corporeal, to consist in the *excitement* of the *nervous system*, and especially of the brain, which unites the different parts, and forms them into a whole. But, as certain other functions of the body are necessary to the support of this excitement, we thence learn, that the causes of death may be of two kinds; one that acts *directly* on the nervous system, destroying its excitement; and another that *indirectly* produces the same effect, by destroying the organs and functions necessary to its support. Of the first kind are chiefly the causes of sleep operating in a higher degree; as cold, sedative passions, poisons, and all causes of very violent excitement.

This doctrine of EXCITEMENT and COLLAPSE, with *other expressions*, have caused some to believe that Dr. Cullen gave the first hint to Dr. Brown for the establishment of his celebrated system, yet upon comparing the theory and practice of the two, we shall find a wide difference; and as the one attributed every thing to the brain and nerves, so the other attributed all the phenomena of life to the fibrous system, extending his doctrine to plants, which are
living

living bodies, but without a nervous system. Dr. Cullen's system has, however, great merit.

If Dr. Cullen did not lay the foundation of the true system of physic, he had, however, a principal share in the merit of delivering medicine from the fetters of the Latin, and introducing the English language, as the vehicle of public instruction in the university of Edinburgh. Much of the revolution since experienced in medicine, I believe, may be ascribed to this circumstance. The many improvements which have lately been made in medicine, must chiefly be ascribed to the present fashionable custom of communicating medical knowledge in the English language. By this means our science has excited the notice and inquiries of ingenious and observing men in all professions, and thereby a kind of galaxy has been created in the hemisphere of medicine. By assuming an English dress, it has moreover been prepared more easily to associate with other sciences; from each of which it has received assistance and support.

In his intercourse with his pupils Dr. Cullen was truly kind and affectionate. Never have I known a man who possessed in a higher degree those qualities which seize upon every affection of the heart. He knew the rare and happy art, as circumstances required, of being affable without being sociable; sociable without being familiar;

miliar; and familiar, without losing a particle of respect. Such was the interest he took in the health, studies, and future establishment of all his pupils, that each of them believed that he possessed a pre-eminence in his friendship; while the equal diffusion of his kind offices proved that he was the common friend and father of them all. Sometimes he would lay aside the distance, without lessening the dignity of the professor, and mix with his pupils at his table upon terms of the most endearing equality. Upon these occasions his social affections seemed to have an influence upon his mind. Science, sentiment, and convivial humour, appeared for hours together to strive which should predominate in his conversation. I appeal to those gentlemen, who have shared in the pleasure which I have described, for the justice of the picture which I have drawn of him at his hospitable table. They will recollect, with me, how agreeably he accommodated himself to our different capacities and tempers; how kindly he dissipated our youthful blushes, by inviting us to ask him questions; and how much he taught us, by his inquiries, of the nature of diseases of our own districts.

From the history that has been given of Dr. Cullen, we shall not be surprised at the reputation which he gave to the university of Edinburgh, for upwards of thirty years. The city of Edinburgh during his life became the emporium
of

of medicine. But let me not here be unjust to the merits of his illustrious colleagues. The names of Whytt, Rutherford, the Monroes, Black, the Gregories, Hope, and Home, will always be dear to the lovers of medical science. May every healing plant bloom upon the graves of those of them who are departed ! and may those who have survived him, together with their new associate, the learned and laborious Dr. Duncan, long continue to maintain the honour of that justly celebrated school of medicine !

It remains now that I add a short remark on Dr. Cullen's conduct as a physician and a man.

In his attendance upon his patients, he made their health his first object. So gentle and sympathizing was Dr. Cullen's manner in a sick room, that pain and distress seemed to be suspended in his presence. Hope followed his footsteps, and death appeared frequently to drop his commission in a combat with his skill. He was compassionate and charitable to the poor ; and from his pupils, who consulted him in sickness, he constantly refused to receive any pecuniary satisfaction for his services.

In his intercourse with the world he exhibited the manners of a well bred gentleman. He exercised upon all occasions the agreeable art, in which true politeness is said to consist, of speaking with civility, and listening with attention to every body. His conversation was at all times
animated,

animated, agreeable, and instructing. Few persons went into his company without learning something; and even a common thought, by passing through his mind, received an impression, which made it ever afterwards worthy of being preserved.

He was a strict œconomist of time. He seldom went out of his house in his carriage, without a book in his hand; and he once told me, that he frequently employed one of his sons to read to him after he went to bed, that he might not lose that portion of time which passes between lying down, and falling asleep.

He was remarkably punctual to all his professional engagements. He appeared to consider time as a species of property, which no man had a right to take from another without his consent.

It was by means of his œconomy and punctuality in the use of time, that he accomplished so much in his profession. I have read, says Dr. Rush, of some men who have spent more time in their closets, and of others who have done more business; but I have never seen, nor heard of a man, who mingled more study and business together. He lived by rule, without subjecting himself to the slavery of forms. He was always employed, but never in a hurry; and amidst the numerous and complicated avocations of study and business, he appeared to enjoy the pleasure of society, as if keep-
ing

ing company and conversation were the only business of his life.

It pleased God to prolong the life of Dr. Cullen to a good old age. He lived near 78 years. He lived to demonstrate how much the strength of the faculties of the mind depends upon their constant exercise. He lived to teach his brethren by his example, that the obligations to acquire and communicate knowledge, should cease only with health and life; and lastly, he lived to reap the fruits of his labours in the most extensive fame; for not only his pupils, and his works, had conveyed his reputation; but canvass, paper, and clay, had borne even the image of his person to every quarter of the globe.

He resigned his professorship in the autumn of 1789, on account of bodily weakness, and died in the month of January of the year 1790; a year fatal to the pride of man; for this year Franklin and Howard, as well as Cullen, have mingled with the dust. During the interval between his resignation and his death he received the most affectionate marks of public and private respect. The city of Edinburgh voted him their thanks, and presented him with a piece of plate. This instance of public gratitude deserves our particular attention, as it is more common for cities to treat their eminent literary characters with neglect during their lives, and centuries afterwards to contend for the honour of having

ing given them birth. And the different medical societies of Edinburgh followed him to his chamber with addresses full of gratitude and affection.

But while we celebrate the praises of Dr. Cullen, let us take care lest we check a spirit of free inquiry, by too great a regard for his authority in medicine. I well remember an observation suited to our purpose, which he delivered in his introduction to a course of lectures on the Institutes of Medicines in the year 1766. After speaking of the long continued and extensive empire of Galen in the schools of physic, he said, "It is a great disadvantage to any science to have been improved by a great man. His authority imposes indolence, timidity, or idleness upon all who come after him."—Let us then avoid these evils in our veneration for Dr. Cullen.

*Life of Dr.
Brown.*

We come now to the history of him who may with truth be reckoned the father of the true science of medicine. Before Dr. BROWN'S time all was involved in mists and errors. Others might have shone forth like a meteor through the gloom, but in the writings of Dr. John Brown we see generally the effulgence of the noon-day. He was educated in physic by Dr. Cullen. Dr. Brown's knowledge of the Latin language * served

* It is recorded that Brown, even when a boy, displayed a genius for literature, far superior to any scholar in the grammar-

ed him as an introduction; and his circumstances might have induced Dr. Cullen to believe that he could render this talent permanently useful to himself, or he had been struck with the superior

grammar-school of Dunse, according to Mr. Cruikshank, who was an able master; and Mr. Wait testifies he was a prodigy, being soon able to read with the utmost facility both the Latin and Greek languages; and so astonishing was the power of his memory, that he could recite a page or two of any book after once or twice reading it. John Brown continued at the grammar school at Dunse until twenty years of age, when he was appointed private tutor to a family of some distinction in the neighbourhood, after which he returned back in capacity of usher to the same school, where he staid a year. He was ambitious of settling at Edinburgh. He was aware that students of physic are in general by no means qualified to hold a discourse in Latin. Hence, before the examination for a doctor's degree, which is carried on in Latin, it is common to have recourse to a private instructor, who contrives answers to the questions that may be probably put. This preparation is called *grinding*, and *cranning*. The translation of inaugural dissertations into Latin, which the students, in most instances, compose for themselves in English, is another occupation, that a good scholar might derive emolument by at Edinburgh, the gratuity for a translation being from five to ten guineas. Of his qualification for these employments accident shortly furnished him with an agreeable proof. An application of this sort was made to him, and what he did was highly approved of. He accordingly set out for Edinburgh, and upon his arrival he addressed a Latin letter to each of the Medical Professors. In consequence of which they each presented him with a ticket of admission to their lectures. Hence the origin of his first acquaintance with Dr. Cullen.

abilities of this young man. Taking him therefore under his immediate patronage, he gave him employment as a private instructor in his own family, and spared no pains in cultivating his friendship: this favoured pupil was finally permitted to give evening lectures, in which he inculcated the doctrines of Dr. Cullen, and as Dr. Beddoes relates, read from Dr. Cullen's own notes. But, alas! friendship originating in protection, is very prone to terminate in enmity, unless where difference of rank and pursuits totally preclude competition. These two great, but opposite geniuses, however, lived for several years in the strictest friendship. Dr. Brown's eldest son was not christened only William, but had also the surname of Cullen, attached to his name, being named by his godfather, *William Cullen Brown*. It is observed, that such was their intimacy, that Dr. Brown could take, whenever he pleased, a bottle of wine from Dr. Cullen's cellar; and during all this time no man in Dr. Brown's company could contradict any of *Cullen's* opinions without receiving an acrimonious answer. A medical chair happening to become vacant by the death of Dr. Gregory, Dr. John Brown gave in his name as a candidate. The magistrates of Edinburgh had the appointment of this office. They inquired of Dr. Cullen whom this unknown candidate was, who is reported to have exclaimed in the dialect of his country, "Why, sure, this can never be
" our

"our Jock!" The haughty temper of Dr. Brown had never once solicited the interest of his friend, and had even idly conceived, that pre-eminent qualifications were sufficient to secure success. His application was in consequence set aside. Brown with great difficulty stomached the affront, and when he afterwards offered himself as a candidate for the philosophical society, which published the Edinburgh Essays, and was rejected, he ascribed the whole to Dr. Cullen, and broke out into an avowed enmity. He publicly complained, "that his open conduct to him was friendly, when his ruin was premeditated, the plot secret, a dark Catalinian conspiracy. Accordingly his suspicions were late, the full detection later." He gave to the public the following particular account of this transaction. "I resolved within myself," says Dr. Brown, "to tear off the mask of pretended friendship. My first step was to make application for being made a member of a certain literary society, to which no man's petition had ever been re-
 * "jected before, or since, foreseeing that I should be rejected. This accordingly happened. I had been previously advised by one of their body not to present my letter of application. This friendly monitor (alluding to Dr. Cullen), knowing that I had meditated a new doctrine of physic, began to be apprehensive lest it should supplant his own, and he was the se-

“cret but prime mover of the plot. My answer was in a tone of firmness, that the application should not be withdrawn.”—After the failure of this bold attempt upon his credit, Brown became completely estranged from Dr. Cullen, and very shortly after published his *Elementa Medicinæ* (Elements of Physic), which have since made such a noise in the world. The approbation this work gained, induced him to give lectures, and his custom was to translate the passages of his work by piecemeal to his pupils, commenting upon each paragraph. In order to increase his fervour while lecturing, he had always by him a bottle of whisky and laudanum, and before he commenced, he would frequently take a glass of the one, and ten or fifteen drops of the other, and even repeat the dose four or five times during the lecture. Between the effects of these stimulants and voluntary exertion, he soon waxed warm, and by degrees his imagination was nearly exalted into phrenzy*; nevertheless

* In the Elements of Physic, Vol. I. p. 129, we have the following curious note.—“Homer observes of the hero, whom he gives for a pattern of eloquence, that upon his first address, that is while he was under some agitation, and had not yet gotten into his train of thought, he was awkward in every motion, and in his whole attitude, he looked down to the ground, his hands hung straight along his sides as if powerless. his whole appearance was torpid. But when he once entered upon his subject, his eyes were all fire, his



Nevertheless it is observed, that when he became animated, he had fine cadences and pleasing tones. As a specimen of the fervour of his genius; speaking of the doctrine of spasm, he says, "that it
 " was first suggested by Van Helmont, and clumsily wrought up into a system by Hoffman,
 " and after being banished by Boerhaave, it
 " found a protector and a friend in CULLEN.
 " This brat, this feeble, half-vital, semi-production of folly, the starveling of strained systematic dulness, the forlorn outcast of the fostering care to which it owed its insect vitality, was now pampered by a crude and indigestible nutriment, was decorated with every
 " foreign plumage, and in this its totally borrowed and heterogeneous form, instead of the

his limbs all motion, with force, grace, and energy. *Upon commencing a lecture, the pupils have often observed the same torpor in the lecturer, and a similar vivacity and life in a few minutes, when he had gotten fairly into his subject: the report which a lecturer's daughter, upon looking through the hole of a door, while the lecture was going on, made to the family and some company then present, was, that her father looked, in his lecture, as if he would look through his heavens.* Mr. Donaldson is one of the few great masters, in the art of painting, who never fail, with a most exact likeness, to display the whole influence of the mind upon the features. A miniature of the author, done by him, as a present, is reckoned the greatest master-piece in these respects, that ever came from the hands of a painter." An engraving from this very miniature we are happy to be enabled to present to our readers.

" hideous caricature, which it was, formed to
 " excite the derision of mankind, it was often-
 " tationously obtruded upon the world as a new,
 " and respectable doctrine, and held up, forsooth,
 " as the formidable rival of my system."—Speaking
 of the professors of medicine he describes
 them " as having a fly attention to reputation
 " for skill; intriguing with their brethren for
 " countenance; opposition to improvement; per-
 " secution of discovery; narrowness of mind
 " under the thin veil of false pretention to li-
 " berality; affectation of decency, all for the
 " purposes of trade; silence, from a conscien-
 " tiousness of inability to speak on general to-
 " pics with advantage; formality, pomp; state-
 " liness; gravity; invincible attachment to the
 " errors of education; ready upon every slight
 " occasion to break out into rage and transport;
 " an invincible bigotry and prejudice; an over-
 " value of what slender learning they may have
 " some pretensions to; and an under-value of
 " what they are conscious they do not possess."

Such was his illiberal language, and hurry of
 ideas, when he had occasion to think of the sys-
 tem, and allowed reputation of his ancient pro-
 tector and teacher. He was soon in a state
 of avowed hostility with the other medical
 professors in Edinburgh. Mr. Wainman, a stu-
 dent in medicine who attended his lectures
 was desirous of quoting in his Thesis on Epi-
 lepsy,

lepsy, paragraphs lxix, lxx, and lxxi, from the *Elementa*, and requested this possession of Professor Monro, submitting to him the following considerations.

1st. That without it he was prevented from saying what *he really believed to be true*, to the manifest injury of his dissertation. And,

2dly. Would be deprived of the liberty other candidates had always enjoyed of quoting from *any author*.

He had an answer as follows.

SIR,

I object to your quotation, not as containing the opinion of *this doctor*, or *that professor*, but as containing such a *jargon* as could not fail to disgrace the candidates, and of course the university. As to the *liberty* you say candidates have always enjoyed of making quotations from *any author* right or wrong, I never heard of it before, and am determined to give it no quarter neither now nor hereafter.

ALEXANDER MONRO.

This letter could not fail to come into Dr. Brown's possession, who publicly complained of barefaced injustice towards those students who attended his lectures, and of unusual severity towards them upon examination when graduating. So indignant was Dr. Brown, that he proceed-

ed in triumph with thirteen of his pupils to Aberdeen, where they took their degree. He described with pleasure his triumphant entry, and the awe that the professors there stood in of him and his pupils: but, as Dr. Beddoes observes, their dispatch more probably arose from their eagerness to partake of the spoils arising from a disunited university. This expedient could not add much to his class, where pupils are mostly under the guidance of parents. His lectures were very thinly attended. But it was observed, that ^{these were the} ~~it was the~~ cleverest students who were among his pupils. His doctrines began to be canvassed in the Royal Medical Society, and so warm were the debates they excited, that a law was obliged to be made, that no duels should take place from personalities committed when discussing the system of Dr. John Brown, under the pain of expulsion.

The reader is probably by this time impatient to have some account of this celebrated system. The author of it says, in the preface to the *Elementa*, that he spent above twenty years in learning, teaching, and diligently scrutinizing* every

* Dr. Beddoes relates, that he learnt from the best authority, that Dr. Brown being anxious to acquire a more minute anatomical knowledge than he had gained by attendance on the public lectures, for some time attended private instructions at five o'clock every morning, continuing with his instructor two hours, and botanical information was added on these occasions to the anatomical.

part of medicine. The first five years passed away in hearing others, in studying what he had heard, implicitly believing it, and entering upon the possession, as a valuable inheritance. His employment, the next five years, was to explain more clearly the several particulars, to enlarge, refine, and polish *. The same number of years had the same occupation; but doubts now often occurred, and faith was staggered. "All this time passed away," adds Dr. Brown, "without the acquisition of any thing valuable in the healing art; without that which, of all things, is the most agreeable to the mind, *the light of truth*, so great and precious a portion of the short and perishable life of man, to me was totally lost! I was at this period in the situation of a traveller in an unknown country, who, after losing every trace of his way, wanders in the shades of night; nor was it till between the fifteenth and twentieth year of my studies that a faint gleam of light, like the first break of day, dawned in upon me."

Contemplating the condition of man, Dr. Brown observed, that he was surrounded by *external agents*, which acted upon him while *alive*, and their effects ceased when dead. These he called *stimuli*, and the *living principle* brought into action by these, *excitability*; and the word *excite-*

* He probably alludes here to the evening lectures he delivered on Dr. Cullen's doctrines. Vide page 130.

ment was used to express the *action* produced by stimuli. Every thing in nature, that had any action on the frame, he conceived to be *stimulant*; and upon this principle *life* appeared to him a *forced state* dependent on *stimuli*; and every disease might be referred to the action of *these powers*, and the condition of the body, which *varied considerably*, never becoming *perfectly stationary*.

By a steady observance of these principles he discovered an affinity between plague and idiopathic dropy, as well as between catarrh and the distinct small-pox; between the confluent small-pox and gout, as well as between peripneumony and mania. And rising gradually from such partial to more general assemblages, he came at last to discern, "that whatever either excessive vigour or debility prevailed in any course of symptoms, they constituted a case of disease precisely the same as all other cases where such increase or diminution of the healthy vigour occurred." Guided "by the same faithful thread of dispassionate attention to nature, through the labyrinth of medical ignorance, empty distinction, and false assertion of facts," he, in fine, attained his universal proposition, "that there are only two idiopathic diseases: and that even these are not produced "by powers different in kind, but only in degree." And from thence he drew his broad conclusion,

conclusion, "That all the states of whatever
 " can be called life in the universe, were ow-
 " ing to this difference of degree. To this re-
 " specting distance, nothing can be added, but
 " that sometimes a change in the solids, as
 " simple and compound, or a line of organiza-
 " tion, may occur. In such cases sometimes affect
 " the general system, whether it does or not,
 " it must be quite differently different from
 " idiopathic affection in its causes and mode of
 " cure; these being local, while those of disease
 " are general." But how complete have the
 aberrations of physicians been from this rule?
 how unobtrusive of its wide and vast illumina-
 tion?

Dr. Brown in the 35th year of his age, was for
 the first time seized with a fit of the *gout*. He
 was told by a great leader in the profession*,
 that he was a man of uncommonly vigorous and
 healthy constitution, and that he should with con-
 " comitant vigour, and with a little pre-
 " vailing over the disease, a habituated cause
 " of the disease, and with other vegetable
 " matter employed as an agent, with a strict absti-
 " nence from every form of animal food, pro-
 " mised almost a certainty that he would never
 " have another fit." He took this, therefore, as a
 fact; the result of much experience and accurate
 observation. He had hitherto almost never ex-

Dr. Cullen.

* *

perienced

perienced pain, and the pain of the gout was rather too exquisite for the first trial of his patience. Betwixt his diffidence in the theories, and some reliance on the facts of medicine, he resolved to risk the experiment. For the course of a year, he made water his only drink, and pure vegetable matter his only food. The event of this regimen was, *four fits* of the gout, each of them of *six weeks continuance*, before he had any use of his affected limb: and indeed, through the whole year, it was but a very short time that he had the free use of it. After this experiment, his distrust of medical facts commenced. He thus reasoned with himself: "If plethora and vigour were the causes of this disease, occasioned by repletion proving an overbalance for evacuation, why did it not happen ten years sooner? especially as he could recollect, that, both at that time, and before it, and after it, his indulgence in food and drink had been greater, and his exercise less, than they had been for a considerable time before this attack of the gout."

He now began to see that he must give up the logic, the philosophy, and the facts, of physic as it then prevailed; that he must forget all his reading and all his knowledge; and, if he did not burn, as Paracelsus did, all the most famous books that came in his way, he must shut them all, and seal each of them with seven seals, till he

he saw what he might make of his own thoughts. The first thing that struck him, examining for himself, was, "that the human machine was " nothing in itself, but in constant and momentary dependance upon a number of powers, " perfectly distinct from it, the operation of " which was necessary to its existence." His intercourse with the means of life, and his observation upon these, taught him, " that men who " are well nourished by food and drink were " strong, and those who had a scanty allowance " of either, but especially of both, were weak." He had observed, " that farmers in Scotland in " good circumstances were much stronger than " their labourers; and that farmers in England in proportional circumstances were as " much stronger than them." He had been told, " that 12 seapoys in East India could not " do the work of one English servant." He had been informed, " that in some counties of " England, the farmers would not engage their " servants unless they undertook to be very dexterous in swallowing the most nutrient animal food." He had discovered * " the field-work in Scotland was tardily carried on by " the labourers, especially the reapers, whose labour is the severest of all; being supported " by nothing but porridge at the rising and setting of the sun, and coarse barley or oat bread

* These are Dr. Brown's expressions.

" distributed to them, not in excessive propor-
 " tion, at dinner, along with a plentiful pro-
 " portion of broth, consisting of nothing but
 " water and purgative fermenting vegetables."
 He had further perceived, " that meat and
 " drink only were not sufficient to support ani-
 " mal life." He found " other circumstances,
 " which he has enumerated in the 6th, 7th, and
 " 8th, par. of his Elements, without any one of
 " which he could see that life could not be sup-
 " ported for the shortest space of time." He
 next reflected, " that a quantity of medical trash
 " stood in the way of his conclusion." After
 getting upon the fair road, in which nature's
 operations respecting animal, and therefore every
 mode of life, were to be prosecuted, he con-
 sidered these with great composure as so many
 " Jacks a-lanterns, that had misled him from the
 " right path into all the bogs and quagmires, over
 " all the precipices of delusion and error." He re-
 gretted " the time that he had lost in the trackless
 " wilderness of false speculation: but he consoled
 " himself with the satisfaction of finding the truth
 " at last. The sun of light arose in his hemisphere,
 " and displayed all the objects around him in their
 " true colours, and figures, and states. By the
 " influence of this newly discovered light, he be-
 " held the phantoms of innate powers of the living
 " system; whether denominated *vires medicatrices*
 " *naturæ*, or increased action of the animated sys-
 " tem

" tem, or reaction, or intermittent types, or
 " irritation supposed to arise from spasm, or ple-
 " thora, or mobility; as so many false meteors
 " which had led him a tedious, painful, fruitless,
 " and malicious dance. The same true light
 " disclosed to his eyes other phantoms, which had
 " formerly appeared to him more like natural
 " figures, but that now stood forth in all the
 " deformity and horror of infernal dæmons.
 " These were symptoms as producing diagno-
 " stics; symptoms as forming the new depart-
 " ment of nosology; symptoms as estimated with-
 " out regard to what they came from, or what
 " might become of them. The sun-beams of truth
 " exhibited all these appearances as a number of
 " monstrous chimeras, to which there was no re-
 " semblance in the simple and just productions of
 " nature, but the illusory abortions of the visionary
 " and disordered heads, to whom the slightest
 " glance of the beauty, uniformity, comeliness,
 " proportion and symmetry of nature, had been
 " denied, and from whose eyes the book of life
 " had been decreed to be shut for ever. He now
 " perceived, that all the pillars, upon which the
 " fabric of physic had stood for ages, must be
 " tore up from their foundations, the rubbish
 " cleared away, and the doctrinal as well as prac-
 " tical part of the profession placed upon a better
 " foundation."

To return to the subject of gout. After
 the former reasoning with himself against the
 commonly

commonly supposed cause and the method of cure of that disease, he observed, "that the stimulant powers necessary to the support of life, could be applied in such a degree as to impair or even destroy life, in a short space of time. This is the noted effect of excess in drinking: and the deaths that stand on record, as produced by intemperance in eating, are so many proofs of the same effect, arising from excess in that mode of stimulus *. Excess of passion, excess of exercise of the intellectual operation, excess in corporeal motion, all tend to the same event. Diseases and sudden deaths have originated from every one of these modes of excess in the use of the stimuli necessary to the support of life." He extended this observation, and found, "that the same effect that could be produced by a high excess of the stimuli in a short space of time, would as certainly arise from a more moderate excess in a longer space of time." In this manner he dis-

* The Brunonian system has been often accused of promoting intemperance. the objection is serious, but the allegation is false. No writer has ever insisted so much, Dr. Brown on the inevitable consequences of excess. "Since," says he, "Providence has granted us a remedy by no means disagreeable or inelegant, and one that is certain, yet let us not abuse his mercy, by bringing on through our own inattention this disease, by these stimulants, for their frequent use must be attended with danger, and our temerity will be at length chastised." Vide Elements, the section on the Gout

covered,

covered, "that death is as unavoidable a result
"of the stimuli necessary to the production of life,
as life itself." This excitement of the cause
of life, he observed to cause a state of debility
which he called *indirect*; and, because there
is a state of debility depending upon deficiency
of stimulus, he called this "*indirect debility*."
All this applied to the disease in question. He
considered himself, some years before his first
fit of the gout, as stronger and more full of
blood than when it happened. Though he
seemed stronger than many others, and perhaps
was so, he did not judge of himself by that rule.
It was a comparison of that kind that misled phy-
sicians to assert, that the gout was a disease of
strong and robust persons. It is so; but they
should have observed, that these strong and ro-
bust persons were less so than they had been
formerly; in short, compared with their former
state of vigour, that they were in a state of de-
bility.

Finding, then, that *debility*, not *plethora* and
vigour, was the cause of this disease, the indica-
tion of cure arose of course. It was, not to
weaken the system by antiphlogistic regimen,
according to the prevailing practice, but to vi-
gorate it; only adopting such that extends of the
means towards the purpose, which terminates

* See his *Essays Med. xix. xx. 1783.*

in *indirect debility* *. Proceeding upon this cautious induction of facts, he saw before-hand, that the plan of cure he was to enter upon must be successful. And the event justified his expectation. In the course of *two years*, excepting two weeks, he had only *one fit*; which, in violence and duration, did not equal a fourth part of any of his former ones. And he was certain that he had even accelerated it by a piece of improper management, which was, intense walking, and the use of tight shoes, and taking a purge of Glauber's salts to remove an inflammatory sore throat. Now, if, what every physician of any observation at all will most readily grant, be taken into the consideration, that fits of the gout become always more frequent as the disease advances in its progress; besides eight fits, which should have happened within the two years we speak of, it is but a moderate supposition that four more should have been added. At that rate, the Doctor should have had 12 fits, instead of one that he had, in the course of the two years. Recollect also, that this was only a fourth part in violence and duration, of any of his former ones: and by multiplying 12 by 4, the ef-

* This distinction of the two states, and causes, of debility is extremely important, called *direct* and *indirect debility*. As an example, cold produces direct debility, heat, producing first tone, if great, next occasions indirect debility; thus the two extremes meet.

fect of his tonic plan will come out to be a reduction of the disease from 48 to 1.

To such certainty has he attained in the knowledge of every thing that is either hurtful or serviceable in the management of himself for the prevention of fits, that he can bring on a small fit any time he pleases, by any one of the articles of regimen that have hitherto been depended upon as the only means of cure. Oat-meal porridge had been particularly specified to him as a very proper article in diet; and he had been advised to depend as much as possible upon this meal. But though it was very agreeable to his taste, from his having been much accustomed to it in his youth; by taking "porridge and ale at any time over night, he is sure next morning of bringing on all the symptoms of indigestion and crudity in the stomach, with looseness of belly, that lay the foundation of a fit of the gout." And, "if he does not prevent further consequences of this hurtful article of diet, by taking his breakfast early, even against his appetite; by either premising or subjoining to his breakfast a pretty strong cordial; and even repeating that, if the continuation of the symptoms should require it; the disease will proceed till it assumes every symptom of a formal and regular fit of the gout. There are, besides loss of appetite and sense of crudity in the stomach, nausea rapidly increasing till it

“ terminates in vomiting; with pain somewhere
 “ about one of his feet, and even evident inflam-
 “ mation. All this concourse he can prevent,
 “ and, when already formed, remove, by the
 “ use of what he calls his *quickly diffusible Stimu-*
 “ *lants*: which are, any wine that is strong and
 “ sound and free of acidity, any strong spirit,
 “ opium, volatile alkali and æther*. There
 “ are others, which, from the analogy of their
 “ resemblance to those we have enumerated,
 “ must operate in the same manner, and there-
 “ fore produce the same effect. They are,
 “ camphor, musk, and some other articles that
 “ may be adduced.” Finding any of the men-
 “ tioned ones sufficient, he has not yet made any
 “ trial of these. “ Drinking the vin de Bourdeaux
 “ in Leyden some years ago, had the same ef-
 “ fect as the porridge and ale: fruit, especially
 “ apples and pears; all green pottage, especially
 “ cabbage; all the several roots which are used
 “ in diet, especially turnips; and even some
 “ which possess a considerable degree of aroma-
 “ tic quality, as Spanish radishes, all the legu-
 “ mina, except green pease, taken in moderate
 “ quantity, with nourishing animal matter; and
 “ particularly pease-pudding, and pease-soup,
 “ have in their turn brought on fits.” The
 “ same has been the effect of “ all the malr li-

* Vide note, page 144.

“ quors, especially strong ale, with a considerable prevalence of acidity : excepting porter, especially when approaching to staleness, for bottled porter, or any porter in which any considerable fermentation is still going on, approaches to the effect of the other beers.”

These are principal particulars, which we think proper to take notice of at present. Suffice it to observe in one word, “ that the whole list of vegetable articles, except those forms of vegetable matter which possess a high degree of aromatic quality, and are therefore used in small quantity, and all sour, fermenting, or vapid drink, are in one degree or other causes of the gout ” With respect to “ water,” the result of his experience was, “ that, in the intervals of the gout, when a person is in his ordinary health, water, which is of itself a debilitating power, if conjoined with nourishing animal food is of no disservice, but, at any time, in a podagric diathesis, conjoined with vegetable matter, it will add to the sum of debility occasioned by that kind of diet. And when the stomach is weak, either as prelude to a fit of the gout, or implying a state of indigestion of any sort, pure water, used as drink, and more certainly in persons who have been accustomed to generous drink, adds great force to the effect of the other hurtful powers.” This conclusion is derived from the most full induction

induction of facts. "The doctor lived one
 " year upon water, during his confinement to
 " vegetable food: he lived for another year on
 " it, when he betook himself to his tonic regi-
 " men. In this case he drank water with his
 " meals, and abstained from all stronger drink,
 " without any harmful effect, whereas, in the
 " other case, he never used water to any ex-
 " tent, but with the most chilling, debilitating
 " effect."

Infinite is the advantage that has accrued to the profession, from this well conducted scrutiny into every article of diet in ordinary use among mankind. The effects of it before, had not only been judged of at random, and therefore very false conclusions been drawn with regard to them, but such has been the capricious consequence of chance, that over-ruled this whole affair, that it has most inexplicably happened, that two general conclusions, diametrically opposite to the truth, have been the final result of all speculation on the subject. One of these conclusions was, that vegetable food, as a part of antiphlogistic regimen, and watery or no drink, have been supposed the only proper means of preventing fits of the gout; and full stimulant diet the only ones productive of them. "The contrary," says Dr. Brown, "has been proved to be the truth, by an
 " ample induction of facts, that all future obser-
 " vation will for ever confirm and justify."

Besides this account of diet in the conduct and cure of the gout, we have only to add, from the same authority to which we owe the former detail, "that though vegetable matter has the hurtful, and animal, the beneficial tendency, hitherto ascertained; yet, when the stomach is in its ordinary healthy and vigorous state, a certain portion of vegetable matter may be usefully conjoined with full meals of animal matter. For our author perceived, that the most filling and stimulant matter of that kind, without such a proportion of vegetable, failed in producing its best stimulant effect." He felt in himself, and inferred from the universal practice in meals, "that without a portion of bread, and certain other vegetable matters, satiety was never obtained: that there was always what, according to vulgar perception, would be called a *want in the stomach*." He studied this affair; and the result of his study was, "that there was a certain quality in alimentary matter which bore a certain relation to the excitability in the stomach*;" This relation, he perceived, was a property in the alimentary matter, from its "kind," not its "quantity," to operate upon the "excitability," and produce "excitement." Such, he discerned, was the effect of all matter in so far as it is alimentary;

* El. Med. vi. vii. viii. ix.

but chiefly of "animal matter," and is im-
 perfectly of "vegetable." And hence it is,
 "that the former is so well, and the latter so ill
 "suited to answer the purpose of aliment. But
 "after obtaining the best effect that could be
 "procured from animal-aliment, the most pro-
 "per in kind, and administered in the most ex-
 "act quantity, there was still a stimulus want-
 "ing, arising from a different mode of opera-
 "tion." While he observed "that animal ali-
 "ment might be rendered so rich in quality,
 "that the full stimulus arising from its quality
 "might be obtained in a small bulk, still the
 "meal would not be sufficiently gratifying with-
 "out the taking in of some matter, which add-
 "ed nothing to the other operation but an ef-
 "fect arising from bulk. Eggs, for instance, are
 "highly nutritive; and greater nutrition still may
 "be procured from jellies and rich soups, but no-
 "body would be gratified with meals consisting
 "of these alone." Hence I learned, "that be-
 "sides the stimulus of aliment arising from its
 "quality, which he therefore denominated *di-*
rect, that another stimulus arising from quan-
 "tity * was necessary; to this he gave the ap-

* How little is this suspected to be the Brunonian doc-
 trine. Man is foolishly represented by some Brunonians to
 want only *stimuli*, and no allowance made for the necessary
 wastes of the system. Dr. Brown on the contrary has
 never forsaken the spirit of a true philosopher.

"pellation

" pellation of *indirect*. As the direct stimulus
 " arose from a certain quality, he saw it required
 " certain matters possessing that quality in order
 " to obtain it. These matters he found to be
 " *animal*, possessing the quality in a high and
 " suitable degree; and *vegetable matters*, possess-
 " ing it in a very low and imperfect degree.
 " While the latter, therefore, were disqualified,
 " as we have said above, from affording the di-
 " rect stimulus, because nothing but bulk, giv-
 " ing distension, was requisite to the indirect, he
 " saw that they would be suitable enough to ef-
 " fectuate it, however low they might be in the
 " scale of direct stimulus that they contained, or
 " perhaps though they contained none at all."
 He saw " it was certain forms of matter, agree-
 " ing in containing in common the quality
 " of direct stimulus, that answered the first pur-
 " pose; but that any matter, whether its direct
 " stimulus was weak or wanting altogether, pro-
 " vided it was not disagreeable to the stomach,
 " would suffice for the second." Of this prin-
 ciple, so accurately explained and clearly stated,
 the application to practice was, " that vegetable
 " matter, in moderate proportion, ought to be
 " united with such a proportion of animal, as
 " would prevent bad effects arising from the for-
 " mer by the predominancy of its salutary stimu-
 " lus: that, whenever a person found his stomach
 " strong,

“ strong, and his system in perfect health he
 “ need not torment himself by over anxiety to
 “ avoid excess in the vegetable matter; and, on
 the contrary, that he may follow his inclination
 to a certain extent. But, upon the first feel-
 ing of indigestion, he insists that too much cau-
 “ tion cannot be used; and he contends, that the
 “ only absolute security is nearly a total abstinence
 “ from every kind of vegetable matter.”

In the course of this inquiry into the effects of
 all the several articles of diet, our author extended
 his observation to other parts of management.
 He went into the consideration of “ sleep” and
 of “ exercise,” and varied and repeated his experi-
 ments on both. “ Too little sleep, under his
 “ vegetable diet, he found a most prodigiously
 “ hurtful power. The diet weakened him ex-
 “ cessively, and produced the effects we have
 “ mentioned: and this weakness was of the direct
 “ kind. His ordinary corporeal and mental oc-
 “ cupations proved fatiguing, and therefore also
 “ weakening; but this weakness was of the in-
 “ direct kind. The former originated from in-
 “ sufficiency of stimulus; the latter from the sti-
 “ mulus being carried to excess under the conco-
 “ mitant circumstances, and therefore rendering
 “ the system unfit for receiving excitement from
 “ it, by exhausting the principle upon which all
 “ the several stimuli only can operate in produc-
 “ in,

"ing excitement, viz. the excitability *. As part
 "of the debility was of the indirect kind, arising
 "from the stimulus of mental and corporeal ex-
 "ercise exhausting excitability, and therefore sus-
 "pending excitement, a sufficient quantity of
 "sleep operated by suspending the excess of sti-
 "mulus which produced this suspension of ex-
 "citement, and therefore by giving occasion to
 "the restoration of the excitability, and an op-
 "portunity to the exciting powers, remaining in
 "the system, to act with effect. Too short sleep
 "preventing the completion of this process, al-
 "lowed the indirect debility to remain, in con-
 "sequence of the excessive stimulus, exhausting
 "the excitability, being not sufficiently suspend-
 "ed." This is the explanation of a fact that
 he had repeatedly experienced, viz. "that short
 "sleep is one of the most powerful causes of de-
 "bility in general, and of gout in particular."

With respect to "exercise," he found, "that,
 "either when very intense or unusual, it also
 "proved very powerful in renewing fits of the
 "gout." It has been said, that the first fit
 which appeared after the institution of the tonic
 plan of regimen, was induced upon the occasion
 of his having, contrary to usual practice, walked
 a great deal in the course of a day or two. And

* See the El. Med. ix. x. xv xvi. xviii. xix. xxi. xxii.
 xxiii. xxiv.

he has experienced, both before and after that
 time, that the fatigue of walking is very power-
 ful in bringing on fits. That walking, in certain
 circumstances, could bring on fits of the gout,
 is a fact not unknown to former physicians. But
 as it clashed with another fact directly opposite to
 this, which was, that indolence and sedentary life,
 conjoined with full and stimulant living, was the
 principal circumstance that induced the gout at
 first, and was therefore supposed still more cer-
 tainly to renew the fits of the disease; from this
 seeming contradiction of effect and cause, phy-
 sicians were all thrown into an inextricable per-
 plexity; the solution of which, upon the Bruno-
 nian principles, is perfectly easy. "Exercise, where
 "habitual, and rendered safe by such habit, and
 "never carried to an immoderate degree, upon
 "the whole, affords a stimulus highly requisite
 "to human health, and suited to prevent all dis-
 "eases of debility, and the gout among the rest.
 "The proper degree of it, producing this effect,
 "depends not more upon moderation of its use,
 "than upon a proper degree of stimulus being
 "thrown in in the form of diet, to enable a per-
 "son to endure it and be benefited by it. When,
 "therefore, neither too much nor too little of the
 "stimulus of food and drink is taken in; or,
 "when any error in either of these extremes has
 "been committed, if this has been corrected by
 "increasing or diminishing the exercise in pro-
 "portion

“ portion to the deficiency or excess of the other
 “ stimulants; exercise, supporting egestion, and
 “ otherwise stimulating, so adjusted to the quan-
 “ tity of ingestion taking place, proves one of
 “ the most natural and permanent stimuli that
 “ can be applied to support human vigour, and
 “ prevent diseases. But the destruction of this
 “ balance, in consequence of too high a stimu-
 “ lus from diet constantly going on, and pro-
 “ ducing a gradual tendency to indirect debility,
 “ and a habitual deficiency in exercise, which is
 “ a means of direct debility, as implying that the
 “ proper degree of stimulus which it is calculated
 “ to give, is habitually withheld, is liable to pro-
 “ duce other diseases of direct debility, and the gout
 “ among the rest ” Hence it is that the luxu-
 rious and indolent are the principal, and almost
 only, victims of this and similar diseases depend-
 ing upon debility, the chief and prevalent part of
 which is of the indirect kind. “ Again, when the
 “ stimulus of diet is employed in a very low
 “ degree, and that of exercise carried to a very
 “ high degree, which is a state of debility, the
 “ prevalence of which is of the direct kind;
 “ then it is that persons will not fall into the
 “ form asthenic disease, to which the denomina-
 “ tion of *gout* is given; but they will fall into
 “ other diseases of an equal, or even more per-
 “ nicious, tendency. Dyspepsia, diarrhœa, some-
 “ times conjointly, seldom separately, icterhus,
 “ dropsy, or even putrid fever, and such like
 “ forms

“ forms of morbid state, depending upon direct
 “ debility, will be the consequence of such hurt-
 “ ful management. The diseases prevailing
 “ among the poor people, who are commonly
 “ starved, and oppressed with assiduous excessive
 “ labour, afford many instances of diseased state
 “ originating from this source of direct de-
 “ bility.” This matter, therefore, placed in the
 light in which we have set it before our readers,
 will explain both the cause of the error of phy-
 sicians in supposing exercise, without limitation,
 to be an effectual means of preventing the gout;
 and it will point out the occasion of their embar-
 rassment, upon finding that after a person has fallen
 into the gout, any unusual exercise will bring
 back attacks. “ If exercise be properly adapt-
 “ ed in its degree to the stimulus of diet thrown
 “ in, no disease will happen. If the balance be
 “ destroyed, as in the first-mentioned case of er-
 “ roneous management, the gout will not hap-
 “ pen, but other forms of the same kind of dis-
 “ ease will; which is a verbal, but no real differ-
 “ ence. In the second case, the gout will hap-
 “ pen; implying, that a disease of debility has
 “ appeared in consequence of the means neces-
 “ sary to the support of life having been car-
 “ ried too far, with the effect of inducing debi-
 “ lity, upon a principle now often explained,
 “ and by this time sufficiently familiar to our
 “ reader: for we must take it for granted, that,
 “ from

“ from the explanation already given, the principles of this doctrine are sufficiently cleared up, at least in so far as we have occasion to touch upon them.” With respect to exercise we conclude, “ that uniform, equal, and gentle exercise, conjoined with the plan of regimen detailed as above, is the proper method of preventing fits of the gout; but that excessive exercise, or a sudden transition from sedentary life to a degree of it not immoderate in itself, but rendered so by abstinence from the due degree, is alone, and more certainly when conjoined with the other hurtful powers, a most powerful cause of the return of pyroxyisms.”

As the gout is a disease of debility pervading the whole system, but more especially affecting what the Doctor calls the internal and external surface of the body; that is to say, the stomach and the rest of the alimentary canal, and what is known to every body by the appellation of *external surface*: in the former of which it manifests itself by all the symptoms of indigestion and a weakened state of the intestines; and is as discernible in the latter by a sense of languor perceptible in every part, where it shews itself by that feeling of which every person can conceive an idea from the recollection of his feelings, especially in his thighs and legs, either when he begins to be under the influence of sleep, or when he is awaked from sleep, before it has had its full course. It is therefore next to be observed,

“ that

" that besides taking a proper quantity of sleep,
 " and supporting the internal surface by proper
 " dietetic materials, the tone of the external sur-
 " face should every where be sustained by the
 " application of a proper degree of tempera-
 " ture. And as the legs and feet are peculiarly
 " liable to the prevalence of debility, they should
 " therefore be carefully kept warm. Silk stock-
 " ings, unless used as upper ones, should be
 " avoided, especially in winter, by every po-
 " dagric, and worsted ones, with flannel socks
 " next to the feet, only used." To illustrate the
 propriety of this direction : among other hurt-
 ful powers by which he can bring on a little fit
 of the gout at any time, he can produce the same
 effect " either by curtailing his sleep, or exposing
 " his body, especially his legs and feet, to cold
 " alone, and more certainly cold, conjoined with
 " moisture."

After thus fully instructing himself in the na-
 ture, cause, and cure of the gout, and finding
 himself highly rewarded for his discovery by the
 great abatement of pain and distress which he
 had experienced in consequence of a different
 practice, he rested satisfied with the progress he
 had made in the knowledge and treatment of this
 disease, and thought it unnecessary to give him-
 self the trouble of shortening or alleviating fits
 when they occurred.

Difficulties, however, still remained, which his
 pupils,

pupils, desirous that the doctrine should be as perfect as possible, wished to have every object removed, and which his opponents could urge against it. It was his duty to gratify his pupils; and it was the common interest of the cause to silence his adversaries. The manner in which he did so claims attention. He had brought on a slight fit of the gout by unusual exercise in walking. This was an opportunity for making an experiment, which was to decide the whole controversy. A person called for him before dinner, who was in the way of business, and insisted upon his being social, which might have led him to drink more than he wished in the forenoon, unless he had been particularly on his guard, until he had collected half a dozen of his principal pupils * to dinner, and drank with them till he only, in consequence of what he had taken before, was somewhat affected. He told them he had planned some degree of intoxication in order to explain many inflammations, which were universally understood to be accompanied with, or to depend upon, phlogistic diathesis. Before the application of the stimulus we speak of, he had not been able to put his inflamed foot to the ground, and had supported himself, in any little motion that he

* These gentlemen were, Dr. Stephens, Dr. Wainman, Dr. Byam, Dr. James Campbell, Mr. Richard Codrington, Mr. John Howel, and Dr. Jones.

chose to make through the house, by his sound extremity, assisted by the use of a staff. But before he dismissed his company, he recovered the perfect use of his affected leg. The inference from which is plain, viz. “that the inflammation
 “ in the gout does not depend upon excessive vi-
 “ gour occasioned by the excessive use of stimu-
 “ lant powers previously applied, but upon a
 “ state of the system diametrically opposite to
 “ that, viz. debility induced by a previous appli-
 “ cation of weakening powers; and that its cure
 “ is not to lower the vigour of the system by the
 “ use of debilitating or insufficiently stimulating
 “ powers, but to raise it by the use of powers
 “ highly and quickly invigorating.” And the benefit redounding to the curative part of this, and other diseases, accompanied with a similar kind of inflammation, must be obvious to every one. The fact is not limited to the case of the gout *, though it would remain still a highly me-
 ritorious

* The general inductions of Dr. Brown are the most exceptional parts of his doctrine. It does not accord with common reasoning to suppose that all diseases have the same origin, although all stimuli have an undoubted ultimate similar effect on the living fibre, that of inducing debility. To obviate this is all that we can do, when the causes of disease are beyond our reach, but as medicine advances these may be discovered, and the true scientific practice established. Thus if a person was to take a powerful poison, who would not rather expel or correct it, than obviate its ef-
 fect

ritorious one if it were so; it grasps many other cases to be enumerated.

As the gout, as we have before shewn, affects the alimentary canal, and especially the stomach, and in its course is attended with symptoms similar to those that occur in dyspepsia; Brown was desirous to know if there was any affinity betwixt these diseases, and he found that dyspepsia

affect on the frame? Should a person swallow a large dose of opium, the first indication of cure would be to expel it from the stomach. A child was in seeming agony, and shewed evident marks of great excitement. The Brunonian bled and blistered and purged, to reduce the system. It was found that a pin had run under the scapula; surely the first indication was to take out the pin, afterwards to correct the sthenic diathesis. So in the gout, the debility and inflammation is occasioned by some cause, and chemistry perhaps hereafter will discover that this is a superabundance of *phosphoric acid*, to be corrected by alkali, sulphur, and whatever disoxygenates: for in gouty patients, during the paroxysm, none or very little phosphoric acid can be procured from the urine; and the sweats, and other excretions shew a superabundance of this acid principle; the same also is shewn from the florid complexion. The formation of calculi in gout proves also the superabundance of phosphoric acid, or the defect of the kidneys in retaining it off. Rheumatism is said to be allied to gout, and probably arises from the same cause, the superabundance of phosphoric acid; and hence the benefit in this disorder arises from drinking the mephitic alkaline water. The stone and disorders of the kidneys bear the next analogy; and the reader will perceive that this doctrine of these diseases, if true, is a great advance on the Brunonian principles.

equally with gout depended on debility, and yielded to stimulant remedies *. Nay, he afterwards ascertained, that all spasmodic convulsive diseases of the alimentary canal †, and above two thirds of the diseases of children, were of the same stamp.

Continuing his investigation of spasmodic and convulsive diseases, when they occupy the organs of voluntary motion ; he discovered that their nature was also the same in kind, but only greater

* An emetic and purge should be premised before the exhibition of tonics, to clear away the mucus, which is apt to collect in weaker habits, and our remedies then get at the *living fibre*. It is thus we rake away the dust, before the external air can have a due effect on the fire.

† Children have frequently a diseased secretion of bile, which appears in green stools. This irritates the bowels, which throw out mucus. Part is absorbed, and the mesenteric glands become diseased. A feropulous constitution ensues, with the whole melancholy catalogue of evils, as worms, chronic inflammation of the eyes and eyelids, white swellings, &c. All this dreadful train of symptoms from one original stock might have been avoided by purging, as often as the stools in infants appear *green*, and afterwards by giving some tonic. But the *purging* is most essential. I hope what I have here said will be attentively considered by mothers and practitioners, persuaded of its high importance as a practical observation, prevention of disease being always preferable to cure. The Brunonian practice employed here *without occasional evacnants* would speedily destroy, and indeed has been the destruction of thousands.

in degree ; as they are exemplified in the spasms and pains, that occur in various parts of the external surface of the body, and in epilepsy, and in tetanus, themselves. Hence he discerned, that a vast number of affections, in which upon the supposition of their being inflammatory, no limits had been set to the use of the lancet, instead of arising from an over-proportion of blood and excessive vigour, or any other such cause, depended upon an under-proportion of that fluid, and other causes of debility, and were to be cured, not by bleeding, or any other evacuations, but by filling the vessels, and restoring the strength of the whole system.

At first, for the purpose of removing fits of the gout, he went no farther than the use of wine, and other strong liquors, with nourishing food, that is, seasoned meat, and kept the more powerful remedies in reserve. But, for many years past, his surprising success in the use of the latter, has enabled him to find in opium and some other stimuli, the secret of repelling the fits of the gout as often as they returned, and, at the same time, of re-establishing the healthy state, a secret that has hitherto been so much wanted and despaired of*. This he has often effected both in himself and in other persons. It is now seven years since he has been able entirely to prevent the return of this disease.

* Vide Note, page 144.

By similar instances in actual practice, he found that bleeding discharges, which are called hæmorrhages, do not depend on plethora and vigour, but upon penury of blood or debility arising from some other source, and therefore he rejected them from the number of sthenic diseases *; for he saw, that bleeding, other evacuations, abstinence, cold, and sedatives, as they are called, proved hurtful; and that the stimulant plan of cure alone was successful. Even wine and brandy, which had been thought so hurtful in these diseases, he found the most powerful of all remedies in removing them. Hence he learned, that in all the diseases, in which others had supposed there was abundance of blood, there was a deficiency, that the real cause of these diseases was debility, arising from defect of blood and other stimuli; and that stimulants, given in proportion to the degree of the cause, were the proper remedies.

By the light that thus beamed in from practice, he saw, that the cause and cure of fevers, both intermittent and continued, were the same.

With respect to the inflammation, real or supposed, occurring in the end of typhus, in a concurrence of symptoms of the highest debility compatible with life, manifested by signs of excite-

* Sthenic diseases, as will be afterwards explained, are such as depend upon an excessive application of the several powers that otherwise produce health.

ment in the head, and particularly raging delirium, an equal satisfactory experiment as that made by Dr. Brown on himself in a fit of gout, proved the application of the fact in question to that case. A friend of mine, says Dr. Jones, lay in a fever. He was treated in the ordinary way, excepting that he had a scanty allowance of wine; which is a practice beginning to take place among the most violent and powerful opposers of Dr. Brown, in consequence of these practitioners perceiving, from its successful use in his own hands, and in those of his followers, that it will obtrude itself upon them at last. But their prejudices in favour of the old practice, with which they have been early imbued, oppose an insurmountable barrier to their using it, and the other diffusible stimulants, in that liberal and copious manner in which only it can be of use. Notwithstanding, therefore, the wine that was given him, the symptoms of weakness went on and increased, till it was plain, even to a good woman who attended him as his nurse, that death must be the consequence of the plan of cure, hitherto pursued, being further continued. He had all the symptoms of approaching death; and from which she, in a large course of practice in her way, had never seen one recover. This declaration she made to me in the presence of the landlady of the house. So certain was their expectation of his death, that the clothes in

which he was to be interred had for some time before that been every night laid out. The physicians who attended him suspected that there was a *Brunonian*, as they call the followers of the new doctrine, in the number of the friends who visited the patient; and if he ventured to prescribe any thing for him, that it would be according to the doctrine which Brown taught, and therefore very different from theirs. The nurse was therefore very strictly charged, upon the pain of all mischief which they could do her in her way of business, to see their prescriptions executed, and to admit of no other. That such was the threatening conversation they held with the woman, I am warranted to infer from her own assertion; that she had hitherto prevented my interference, because her means of living were at stake. But now, as nothing but death presented itself to her expectation as the result of the ordinary plan of cure, she thought herself justified to God, in allowing the new mode of cure as fair a trial as the short space of life that the patient seemed to have before him would admit of.

To explain my assertion of her not thinking herself justifiable to man, her words were the following: " I shall give your doctrine a complete
 " trial, upon this condition only, that you will
 " keep the secret. My bread depends upon it.
 " I am ruined if what I am about to do be di-
 " vulged. And if ever it comes out, I tell you
 " before-

“ beforehand, that I will deny the whole matter.” In consequence of this paction, opium in large quantities, because spirits and wine could not be poured in, was administered from 12 o’clock in the day through the course of the night. The consequence of which was, the next morning pretty early, when the physicians visited him, that they declared him better, as I am told; and, as a proof that they thought so, ordered him chicken and chicken-broth. He remained in this happy and unexpected state till the afternoon about four, when he was seized with a raging delirium. This alarmed the nurse and myself. I then consulted Dr. Brown what I should do with my patient. He was not alarmed for the nature of the thing, but for the consequences, if the former plan of cure were returned to, which might prove a cause of the patient’s death, and might afford an opportunity to other physicians to impute that death to him. The rumour, spread among the people in consequence of such a report from physicians of reputation and influence, might, he easily perceived, terminate in his ruin. I told him the nurse wished to see him; and he desired her to be brought before him. She asked his opinion of the case; and his reply was, “ That there was
 “ scarce a physician any where, and more cer-
 “ tainly those attending the patient, who would
 “ not assert, that the present formidable symp-
 “ toms were the effect of the high stimulant
 “ powers which had been administered to him the
 “ night

“ night before. But he added, that if the same
 “ mode of cure were not continued, the patient
 “ would certainly die of a very different affec-
 “ tion from that which they would contend it
 “ was. He endeavoured to assure her, that
 “ there was either no inflammation in the case
 “ at all, or that it was a very different affection
 “ from the inflammation that physicians were
 “ acquainted with: That, instead of requiring
 “ bleeding and other evacuant antiphlogistic
 “ means, it required the very same treatment
 “ which had been last employed. He appealed
 “ to the beneficial effect of that treatment in sup-
 “ port of his opinion; and he asserted with con-
 “ fidence, that the intermission of the stimulant
 “ powers through the course of the day was the
 “ cause of all that had happened: for she told him
 “ she had given nothing of that kind during the
 “ day, from the full persuasion that the patient’s
 “ disease was removed. The purport, in short,
 “ of all this, is, that the present affection was a
 “ disease of debility of the whole system, predom-
 “ inant in the brain in consequence of the
 “ great sinking of strength, which constantly
 “ follows a total cessation of the use of such
 “ highly stimulant powers; and that a sinking
 “ was a consequence of the cause assigned, in
 “ every state of the human body; that dejection
 “ of spirits, anxiety, sadness, and every symp-
 “ tom of diminished vigour, were the ordinary
 “ results

“ results of a quick transition from debauch to
 “ abstinence. He begged, therefore, *as the life of*
 “ *a fellow creature was at stake*, and as she had
 “ been so late a witness of the good effects re-
 “ sulting from the method of cure, the continu-
 “ ance of which he still recommended; that she
 “ would not allow prejudice, and impressions
 “ from false theories of physicians, among whom
 “ she had been conversant, to prevail over the
 “ high probability of success from this mode of
 “ cure.” He dismissed her, after obtaining a
 promise that she would continue the plan of cure
 in question. The prejudice we have spoken of
 had prevented her from completely fulfilling her
 promise; as appeared by the consequence next
 day: when I went back to the Doctor, and told
 him that the patient’s raging delirium was now
 over, in consequence of an imperfect renewal of
 the stimulant plan of cure; that he was now seiz-
 ed with a coldness of all his extremities, pro-
 ceeding rapidly to the more central parts of his
 body. “ Now,” said he, “ is the time to ply
 “ the most powerful stimuli; as the nurse, from
 “ a thorough conviction of this being a symptom
 “ of instant death in all the cases that she had
 “ ever seen, can possibly have no objection to
 “ this plan of cure, after constantly finding every
 “ other fail. She might have been afraid of it
 “ during the continuance of the delirium; but
 “ that apprehension must vanish in the present
 “ case,

“ case, in which it must be natural to her to
 “ expect, that exciting the system promises the
 “ only cure of a case that must evidently ap-
 “ pear to her to depend upon a sinking of the
 “ vital energy.” She was accordingly very readily prevailed upon to throw in very plentifully the strongest cinnamon spirit and rum. The effect answered the Doctor’s prognosis. Next day the patient was better, and never had another relapse.

This cure gave great vexation to the attendant physicians, and all their partizans. Without giving Dr. Brown the least opportunity to vindicate himself from their accusations, by spreading these through all the numerous circles of their friends and his enemies, they had very near ruined his character as a physician, and as a man. They did me the honour, continues Dr. Jones, to involve me in his cause. Their accusations against us both were, “ that we had clandestinely, and
 “ without authority, interfered with their patient, and thwarted their method of cure.” They had consulted lawyers, to raise a prosecution against us. They had deliberated about bringing us before the tribunal of the college of physicians. In short, nothing less was their aim than the ruin of an honest man, and of a most beautiful and numerous family, for saving a man’s life. The news of this reached him, and he received certain information of every thing that the
 most

most active person in the plot was doing against him; of whose folly and malice the rest made a handle. And, last of all, such was their inconsistency, that they made an attempt to disprove that our method of cure had ever been employed. One of them held private conferences with the nurse; and after employing every mode of intimidation which her obnoxious situation suggested, he prevailed on her, as he said, to deny that any part of our mode of cure had ever been administered by her. She was said to have confessed, that *she had deceived me*, to get rid of *my importunities*: and they even circulated a story that I offered her a bribe. All this was weakness and impotence. It was devoid of truth: it even wanted coherence. And the whole fact hung upon the testimony of a poor woman; who, if she acted the part that was alleged, was impelled to it by her situation in life, indigent and at their mercy. The reader will perceive, through the whole of this process, a shameful unfairness and meanness, unworthy of a set of men, whose profession, continues Dr. Jones, if they executed it with liberality, would entitle them to the rank of gentlemen. It was unfair to spread the grossest insinuations against any person's character, without first confronting himself with the accusation. It was mean, and implied consciousness of the badness of their cause, to hold private conferences with a silly dependent old woman, in the absence

of those whom it so highly concerned to have been present to ensure fairness. Circumstantial evidence, the best of all evidence, is totally wanting in their tale; deep malice can be proved, which makes further against their candour and veracity. And who, in his senses, under these circumstances, would place any dependence upon the testimony of a woman in the situation described, or oppose it to a chain of consistent testimony and internal evidence that presents itself on the other side of the question? The reader will recollect the answer to the woman's real, or supposed assertion, of her *deceiving me*, That she declared before the landlady of the house, that she would make a full trial of my mode of cure. And I must be allowed to affirm, that I saw the first dose administered. It was also before the same other woman and myself, that, upon finding the patient so perfectly relieved next morning, she declared that I was the *only doctor*, for that I had saved a life that infallibly must have perished.

The first evening of the commencement of our cure, after two exceeding large doses of laudanum had been given, the patient, who had not slept for 48 hours before, was enjoying a most refreshing sleep, and so much better in the other symptoms, and particularly in the reduction of his pulse from 112 to 92, that one of his attending physicians owned before me at the bedside,

sive, that he was even then surprisngly altered for the better. Further, will this nurse *deny*, that she came to Dr. Brown's parlour along with me, and had the consultation about what was to be done with the new symptom of delirium? And is it possible, that she can have *forgot* the purport of what the Doctor said on that occasion? that she told him she had been equally surpris'd at the wonderful relief obtained in the morning, and alarmed at the formidable relapse in the afternoon? At this interview none were present with her but the Doctor and myself. But it was known to several, and particularly to Mrs. Brown and Dr. Wainman, that she had been there. And all the subsequent steps of the cure were every day communicated to some particular friends; who, if this should any more be called in question, are ready to give their testimony to the truth of this whole process as we have related it. I myself attended this case from the beginning to the end of it, at least four or five times every day; and I do here give my most *solemn declaration*, that the whole relation here made to the reader is truth.

It is not amiss to take notice of a circumstance that occurred early in the disease, in further corroboration of what has been said. One of the physicians, who continued his attendance afterwards, was some how or other called in against the patient's consent. He ordered him tartar

emetic, which the patient by my advice refused ; in place of it, the most diffusible penetrating and powerful stimulants were given in large quantities, and with great success. The physician returning next day, perceived him much relieved. And when, the next day, he was going to impute the merit of the service done the patient to the tartar emetic which he had ordered, he was then told the patient had refused it, and in place of it taken a large dose of laudanum, vol. alkali, and cinnamon water. Upon hearing that, he shook his head ; meaning, according to the practice of the opposers of the new doctrine, that this significant nod should pass among the by-standers, as a proof that there was some mistake in the case : but a paleness was perceivable in his countenance ; and conclusions were drawn from that, which over-balanced the effect of the *nod*. To do justice to every man, and prevent mistake, as there were two physicians attending this case, the physician we have last mentioned was not Dr. Monro. By and by, a little wine was ordered, but not by Dr. *Duncan*.

I shall finish this vile affair, continues Dr. Jones, by vindicating the character of my worthy preceptor, as a man and as a liberal physician. Few persons would think it a crime in any one, if he saw another *killing* a man, and had it not in his power to avow himself his deliverer, *to save his life* even in the most clandestine manner. This simile,

simile, however, applies not to the present case. I attended the patient in question, from the beginning of his fever till the consummation of his cure ; and I was about him before any practitioner was called in. I from time to time consulted the gentleman I have so often spoken of. He gave his opinion of the case, as one in which I was more properly concerned than any other person about the patient. I was his friend ; I had done him service before. One of the physicians was called in by no other authority than mine : the other, by none at all, at least not by mine ; and, as I have before observed, against the patient's consent. My reason for calling one of the physicians was, that as I knew from his Lectures he was no friend of the spasmodic doctrine, I hoped he would lay down a different plan of cure from the evacutory debilitating one, which that doctrine suggests ; that he would have nothing to do with the most pernicious and destructive of all powers, which upon any occasion have been ever employed as remedies in fever, *tartar emetic* * ; and lastly, that he would, upon a fair and candid

* Dr. Brown and Dr. Cullen are no more. Their respective doctrines will now be canvassed with temper. Dr. Brown was certainly right in this case in obviating debility by tonic powers ; but his doctrine of putrid fever has done equal injury with good : for innumerable are the instances where the evacuant plan has saved the life of the patient, for the fomes of putrid fever is certainly at

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candid recital of the plan of cure, so successfully used by Dr. Brown and his pupils, he induced to concur with him in his salutary practice.

These were my expectations; and they were the more sanguine, that I knew the common method of cure of fever had been for a long time altogether abortive. The deaths of students, not to say of others, for 20 years back, so well known to every one, and often so unexpected from the mild manner in which the disease commenced, could not fail to have loosened any man's attachment to that mode of practice, and prepared him for the reception of one so much preferable to it in every respect, and which had never failed even in the worst of cases.

I communicated this reasoning with myself to Dr. Brown. His answer was, "That it was very
" bad; that I was unacquainted with the in-
" tested arts of those men; that all their ideas
" in medicine, and particularly in its practical
" part, were so diametrically opposite to his,

first in the alimentary canal, and even where purgatives are not allowable, glysters, using at the same time bark, opium, and wine, may be advantageously employed. That oxygen is the substance consumed by powerful stimuli was unknown to Dr. Brown, and confirms the use of acids and cold air, along with bark, which his doctrine otherwise would condemn. It is intended in the course of this work to state the Brunonian doctrines, with those improvements which time has suggested, as a duty we owe to truth and the public.

“ that they never could be brought to any sort
 “ of reconciliation. And lastly, he informed me,
 “ that his doctrine and practice had touched them
 “ so much in their tenderest and most exposed
 “ parts, that their passion and hatred to him had
 “ got the ascendant over their reason, so that
 “ there was not the most distant hope that a meet-
 “ ing betwixt him and any of them would be
 “ productive of either harmony or common de-
 “ cency; in short, that the only plan of conduct
 “ they could hold towards him was to seek his
 “ ruin.

“ Non levia aut ludicra petuntur,

“ Sed Turni de vita et sanguine certunt *.”

This he quoted on the occasion. “ However,”
 continued he, “ *as a man’s life is at stake*, and as
 “ he was certain for himself that he would act a
 “ part for which he could acquit himself to the
 “ public and his *own conscience*, he would meet
 “ with this gentleman, and hazard every conse-
 “ quence of such a meeting; provided I waited
 “ upon him, and gave him full intimation, that
 “ he himself had been called in by me in expect-
 “ tation that he would proceed candidly and
 “ harmoniously with Dr. Brown in the treat-
 “ ment of so difficult and dangerous a case:
 “ And,” he added, “ that I should communicate
 “ it to this gentleman, that, in consequence of

* Virgil.

" great service having been rendered to the pa-
 " tient before he fell into the fever, by Dr. Wain-
 " man and me as pupils of Dr. Brown, he had
 " entertained a good opinion of his abilities as
 " a physician, and that he was therefore the
 " only physician whom he had any desire to at-
 " tend him." His constant cry, after the disease
 arose to an alarming degree of violence, was Dr.
 Brown, with whose name he always conjoined
 mine. This is a truth that cannot be *denied*, and
 that the nurse *dare not deny*. This whole conver-
 sation passed between the Doctor and me, in the
 presence of another gentleman; who, after the
 great noise about this cure had commenced, and
 when the doctor was now accused of having clan-
 destinely, and even illiberally, interfered in, and
 counteracted other people's practice, asserted be-
 fore several gentlemen, that he had heard and
 could vouch the truth of the whole: and these
 gentlemen are still ready to attest their remem-
 brance of this gentleman's declaration. Upon re-
 collection, however, and receiving a very dif-
 ferent advice from other friends, who were of
 opinion, that no good could come of the pro-
 posed meeting and coalesced plan of cure; that
 they were too much fettered by their prejudices,
 and impelled to opposition by interest; and too
 severely hurt, from his repeated success in a me-
 thod of cure diametrically opposite to theirs, for
 such mutual advances being made between them

as could terminate in any consistent plan whatever; besides that there was danger of ill blood and indecent conduct in the parties to each other: Induced by these considerations, I never made the proposal to the physician we speak of, which Dr. Brown had so particularly recommended to me. This, with respect to the physician of whom I have been speaking, must appear a satisfactory and honourable vindication of that gentleman from the most unjust charge of having *clandestinely* interfered in, and illiberally counteracted, or attempted to counteract, the practice of other physicians.

With respect to the other physician with whom we have had concern in this case, our process of vindication is very short. One of the most accomplished gentlemen and intelligent physicians who have embraced the new doctrine, and who had surrendered a great deal of prejudice against it to a full conviction of its truth, of which he has at all times made the most determined and open avowal, Dr. Stevens, was desired by a friend to take advantage of a certain intimacy and connexion that he had with the other physician of our patient, and, as a friend, to inform him of the great efficacy of the new practice, and put him in mind of the futility of the common one; and to assure him, that, from repeated experience of his own of the great success of the former, and from every body's knowledge of the

inefficacy, if not hurtful tendency, of the other, there were not the least hopes of recovering this patient from so alarming a concurrence of symptoms, unless the plan of cure were conducted totally according to the precepts of the new doctrine ; to demand his giving it a fair and candid trial, as the decision of the controversy was so closely connected with the dearest interest of humanity, that of preserving life, and averting the danger of death. Dr. Stevens replied, That he doubted if he could use such freedom with this gentleman. as he knew his opinions to be of a very different nature ; and was apprehensive that he could hardly be induced, by any arguments that could be urged in a short conversation, to alter a practice he had been accustomed to for so many years, and in which he was countenanced by most medical practitioners. He went, however, and saw the patient ; and reported, that the case required the most accurate application of the new plan of cure : that there were not the least hopes that either of the attending physicians would yield to any part of it. He added, that he deeply regretted the state of physic ; that he dreaded the event with respect to this patient ; and that neither he himself, nor Dr. Brown, could be of the least service in the case, unless they were left at full liberty to urge the new plan of cure in the most complete manner. It was his opinion,

opinion, therefore, that neither of them should interfere, as it might be attended with very disagreeable consequences.

The reader will now perceive, from a cloud of witnesses, and from a chain of facts, all connected with and supporting each other ; from a full exposition of the motives, intentions, and well-known conduct of the opponents of the new doctrine and its author ; from the surprising cure performed in this case, compared with the fatal tendency and actual fatality of the ordinary practice, even in the mildest cases ; from the corroboration that the new practice in the cure of fevers receives from the similar success of it in all other idiopathic, nay, even in local affections ; from the known interestedness of medical practitioners, especially those who teach and take the lead in the profession, impelling them at all times, and never more than at present, to oppose every innovation, however much it might tend to the improvement of the art, in proportion to its tendency towards the subversion of the systems or doctrines from which they derive all their profit and significance : Lastly. When to all this is added, that the Doctor, *from his love of truth, and profound regard to the highest temporal interests of mankind, has engaged in an enterprise but few men, at any period of civil society, have had either the boldness or the disinterestedness to undertake ; in which his reading and observation could not fail to inform*

him, that he was retarding, if not marring altogether, his advancement in his profession, by opposing in the most determined manner every view in physic which its practitioners hitherto had inseparably connected with their profit and honour : from all this the reader, I say, will readily perceive to which side of the dispute he ought to attach his approbation ; I mean the dispassionate and disinterested reader.

“ Audi alteram partem,” says Dr. Beddoes.

The Brunonians loudly proclaimed this case, reported to have been successful, after Dr. Duncan and Monro had given the patient over. Dr. Duncan, roused by these rumours, applied for information to the nurse and her assistant, to Mr. Isaacson himself, to the mistress of the house where he lodged, to Mr. Edmund Goodwin, and Dr. Monro.

In his letter he has published their respective attestations and depositions upon oath : from which it would appear that the clandestine proposals were rejected, and that only one unsuccessful attempt was made by the negotiator himself to administer a dose of his diffusible stimulants. According to the nurse's testimony, Mr. Jones on her first refusal declared, if she “ would do as “ he desired her, Mr. Isaacson would give her a “ handsome reward when he recovered—that “ the medicine he wished her to administer was “ a bottle

“ a bottle of double rum, of which she was to
 “ give him a glassful, with fifty drops of lau-
 “ danum in it, the first night; and another glass-
 “ ful, with one hundred drops of laudanum in it,
 “ the second night, if the first dose should have a
 “ good effect. To this proposal she answered,
 “ that if such medicines were administered to
 “ Mr. Isaacson in the state in which he then was,
 “ he would not recover to reward either her or Mr.
 “ Jones. To which he replied, that she was a
 “ damned fool for refusing, and that he would
 “ give her two guineas out of his own pocket,
 “ if she would do it. She said, that if the best
 “ graduate in Edinburgh would give her her
 “ apron full of gold, she would not.” This
 woman deposed moreover that one evening,
 while she was employed apart, she heard Mr.
 Isaacson suddenly cry out, “ Good God, what
 “ is this? It is laudanum! I am poisoned!”
 She then observed Mr. Jones by the bedside
 with a tea-cup, containing some liquor, in his
 hand, which he set down on the table, request-
 ing the landlady to give it to Mr. Isaacson at a
 proper opportunity. The landlady asserts, that,
 late one evening, she saw Mr. Jones drop one
 hundred drops of laudanum into a tea-cup, and
 add some wine, which he immediately carried
 into Mr. Isaacson’s room. She followed him:
 he endeavoured to make Mr. Isaacson, who was
 so far delirious that he did not appear to know

Mr. Jones, swallow the contents : “ on tasting
 “ the medicine, he spit it out of his mouth ;
 “ cried out that it was laudanum, and that he
 “ was poisoned ; but to the best of her obser-
 “ vation, he did not swallow any of the me-
 “ dicine ;” which soon after was thrown into the
 fire.

The interview, which the nurse herself vows, that she held with Dr. Brown at his house, may cast some suspicion on her integrity. But she might, says Dr. Beddoes, have been thoughtless ; or, though determined to reject his suit, she might have been pleased with being solicited as arbiters between contending systems ! The rest of the evidence, he adds, is also consistent with her testimony.

Dr. Duncan’s indignation urged him to an immediate prosecution, which, as he was assured by some eminent advocates, would have terminated in the infliction of a severe punishment on the negociator. Dr. Monro discouraged this idea for reasons which it would be injurious not to quote ; they are thus assigned in the letter to Dr. Jones : “ He was principally averse to it on
 “ your account, because he considered you in
 “ the light of an imprudent young man—he
 “ imagined that the mal-practices might be suf-
 “ ficiently proved of you, although they could
 “ not be brought home to Dr. Brown, whom
 “ he considered as the original aggressor. He
 “ was

“ was averse to it on account of Dr. Brown’s wife and infant children, who might have suffered more severely by it than we could easily foresee. And besides this, he thought there was but little danger that Dr. Brown should repeat such practices, and still less chance that he would again find any student to be his assistant in the manner that you had been.” In these reasons Dr. Duncan acquiesced*.

By this event his reputation was much injured. All chance of lucrative employment in his profession destroyed. The cloud was completely burst, and the unfortunate Dr. Brown involved in utter ruin. His receipts not being sufficient to support himself, a wife, and six children, he was thrown into prison for debt, where his pupils followed him at an appointed hour to hear his doctrines.

We have before noticed, that gradually led, as it were, by the hand of nature, around the whole circle of ASTHENIC DISEASES, he became convinced that they all depended upon the same cause, which is *debility*; that they were all to be

* Vide Dr. Beddoes’ life of Brown affixed to a new edition of his Elements. The doctor upon this occasion makes the following remark, which in my mind is too severe. “ By this intrigue all chance of lucrative employment in his profession, *if he had any*, was destroyed. His character among his countrymen suffered *irretrievably*, nor have I *courage without better documents to undertake his vindication.*”

removed

removed by the same kind of remedies, to wit, *stimulants*; and that neither their cause nor their cure differed but in degree. With respect to many **STHENIC DISEASES**, he had the honour of first explaining their origin; he was aware that neither the inflammation, nor the other symptoms attending them, as had been universally believed by systematics, were the cause, but the effect: that the inflammation arose from the cause, *i. e.* the diathesis, or habit, and that it did not occur at all except in cases where the diathesis was very strong. In fine, he experienced in his own person, that catarrh was not produced by cold, according to the common opinion, but by heat and other stimuli, and was removed by cold and other debilitating powers. By this discovery he was led to form a proper judgment of the catarrhal symptoms in the measles: concerning which the great man who so much improved the cure of sthenic diseases, but who never attained to any knowledge of the asthenic, was misled by the alexipharmic physicians. And, as these symptoms are the most dangerous part of the disease, he was right in supposing, that the proper treatment of them was of great importance to the cure of the whole disease. In consequence it came out that the refrigerating antiphlogistic plan was of as much service in the measles as in the small-pox. In sthenic diseases he illustrated the

cause

cause, enlarged the plan of cure, accounted for the symptoms, and reduced the whole to a certain principle; he distributed all general or universal diseases into two forms, a sthenic and an asthenic. He demonstrated that the former depended upon excess, the latter upon deficiency, of exciting power; that the former were to be removed by debilitating, the latter by stimulant, remedies; that the noxious powers, which excited either, were the remedies of the other, and the contrary; and that they acted in the same manner as the powers which produce the most perfect health, with only a difference in degree*.

This class, as you might expect, was small, and his lectures never could have retrieved him, had not a nobleman in London, a stranger to him, but not to his fame, hearing of his situation, generously remitted money by Mr. Donaldson, to pay his debts, and liberate him from his misfortunes. Seeing that he had now no prospect of maintaining himself by the practice of physic, or teaching his system, at Edinburgh, he resolved upon the scheme of quitting his country, and as he proceeded to London with his numerous family, he probably uttered the memorable words of Scipio:

Ungrateful country, thou shalt not even possess my bones.

* We shall hereafter fully investigate the Brunonian doctrine in the course of this work respecting disease.

Immediately

Immediately upon his arrival in London an accident befel him which I have heard Mr. Murray, the bookseller in Fleet-street, relate. The peculiarity of his appearance, as he moved along—a short square figure with an air of dignity, in a black suit which heightened the scarlet of his cheeks and nose—fixed the attention of some *gentlemen* in the street. They addressed him in the dialect of his country; his heart, heavy as it must have been from the precariousness of his situation, and distance from his accustomed haunts, expanded at these agreeable sounds. A conversation ensued, and the parties by common consent adjourned to a tavern. Here the stranger was kindly welcomed to town; and after the glass had circulated for a time, something was proposed by way of sober amusement—a game at cards, or whatever the doctor might prefer. The doctor had been too civilly treated to demur, but his purse was scantily furnished, and it was necessary to quit his new friends in search of a supply. Mr. Murray was the person to whom he had recourse; the reader will not wonder that his interference should have spoiled the adventure.

A London sharper of another denomination afterwards tried to make advantage by the doctor. This was an ingenious speculator in *public* medicines. He thought a composition of the most powerful stimulants might have a run, under the title of Dr. Brown's *exciting pill*; and for the privilege

vilege of his name offered him a sum in hand by no means contemptible, as well as a share of the contingent profits. Poor Brown, needy as he was, spurned at the proposal.

A few words will describe the tenor of this unfortunate man's life after his removal from Scotland. Dr. Brown met with as violent an opposition in London as in Edinburgh. Public opinion can alone awe the body of established physicians in any country into toleration of innovation; and knowledge on this subject was too little diffused for public opinion to operate with effect in his favour. He attempted to open a course of lectures at the Devil tavern, but with trifling success. His new misfortunes confirmed a habit of intemperance. Dr. Cullen, who never mentioned Dr. Brown's abilities without praise, used often to say, that he had a temper very difficult to deal with. He now became more impetuous than ever; his lectures, of which I have one before me in manuscript, is a torrent of invective, and he speaks of the certainty of his system becoming one day triumphant. But he did not live to see that day; he went to bed after lecturing apparently well, and the next morning was found dead in his bed, not without a suspicion of his death being premature.

Oh! *Genius*, art thou to be envied or pitied? Doomed to form expectations the most sanguine, and to meet with disappointments the most mortifying!

tifying? To indulge towards others the most generous wishes, to receive thyself the most illiberal treatment? To be applauded, admired, and neglected? To be a friend to all, befriended, often, by none? Oh! Thou creative, discriminating power, source of inexpressible delights, and nurse of unknown sensibilities, that perpetuate distress. Fancy shall embody *thy* form; and visit the grave of Brown, to drop the tear of sympathy, over that ingenious, unfriended, unfortunate physician.

It would be in the order of this section to trace the introduction and application of pneumatic medicine, but a knowledge of chemistry must be first acquired before this improvement can be properly understood. We therefore hasten to the Progress of Chemistry.

THE
P R O G R E S S
OF
C H E M I S T R Y.

Increscunt quotannis Scientiæ, emendantur quotidie, et ad fastigium suum optatum sensim sensimque, plurimum virorum opera et studio junctis, feliciter properant.

THUNBERG.

SECTION II.

CHEMISTRY is defined by Suidas to be the preparation of silver and gold. The word *κατασκευή* seems to imply no more than the separation of silver and gold from their ores. Suidas adds, that the Emperor Dioclesian ordered, all the books he could procure, which treated on these subjects, to be burnt; lest the Egyptians should by this art grow rich, and be tempted to rebel.

It should, at first appearance, seem strange, that a flat country, like that of Egypt, which was never remarkable for having either gold or silver mines, should be celebrated for the skill of its

inhabitants, with respect to the treatment of metals. But, if we consider the prodigious riches of ancient Egypt, we may, perhaps, find reason to suspect, that it had, however, some other source of wealth than the fertility of the soil. It is not improbable, that the ancient Egyptians carried on a commerce into the inland parts of Africa, where gold ore, or gold dust, was found, and perhaps silver; which traffic, for political reasons, they might conceal from other nations. As the priests ingrossed all the learning, as well as wealth, of the country, these were therefore the smelters and refiners of these ores; and the method of treating them they would probably keep to themselves, both for national and private considerations. Hence, if they wrote upon the subject, whatever they delivered was so involved in allegory, and designedly obscured, that nobody but their own order could find out the meaning. It is even probable, that they pretended to the art of converting baser metals, which they used in their processes, into real gold, the better to conceal the true sources of their wealth. Now when men of learning, in after ages, met with their books, not being able to understand their true meaning, and not knowing how to decypher them, they might take their allegories in a literal sense, and thus believe, that there really was a method of making gold from other metals. When such a notion, foolish as it was, had once begun to prevail, it

*Rise of al-
chemy.*

was

was natural enough for the avarice of mankind to leave nothing untried for the revival of so beneficial an art, supposed to be lost. This mistake was, probably, the foundation for all those researches which have been made after the transmutation of metals; for I can never believe, that there ever was, in reality, any such art; the converting of one metal into another being, in my apprehension, attended with as much difficulty as the converting a stone into a diamond. The mistake was, however, very fortunate for chemistry; because the experiments made on this account gave occasion to the development of many important chemical discoveries.

The priests, in order to support their reputation, wrote books on their pretended science, and had the art of expressing the subject in a mysterious and learned jargon. Several of these obscure writers seem sensible of the reproach, and they promise to speak plain and intelligibly; but instead of revealing, they even express their hidden secrets more obscurely than any of their predecessors.

Afterwards chemistry was seized on as a source of wealth by princes, and it went from priests into the hands of common miners, and smelters of metals, men unacquainted with the liberal sciences, debarred from all commerce with the learned world, condemned to lead their lives in darkness underground, and to support their wretched beings

with coarse and hard fare. Consider these men daily obnoxious to a thousand dangers, dreading what may happen, disturbed in mind, and leading a very uneasy life, trembling at the frequent earthquakes, the rapid torrents from the mountains, at the meteors and damps, the confusions of the gross and sulphurous exhalations, the resoundings of the caverns, and the subterraneous bellowings. Under all this, having no wise or prudent person to consult, who might remove their vain fears, and restore light to their troubled minds: hence they gave their attention to superstitious tales, and fabulous stories, calculated to frighten as well as amuse, and, by increasing melancholy, from fools became madmen. Hence was seriously taught as part of chemistry the belief of forceries, fascinations, enchantments, prognostics, the use of amulets, genii confined in seals, wands, rings, allegories, emblems, types, riddles; and a little truth was so blended with a large farrago of falsehood, that the real science of chemistry became invisible, and nearly obliterated.

The boasted pretensions of the early alchemists and chemists, could not escape the just censure of *ROGER BACON*, an Englishman, who, in the thirteenth century, like a bright star in a dark hemisphere, shone forth the glory of his country. This extraordinary person knew so well how to reduce the powers of nature within the rules of art,

art, as, by their combination, to perform things which far surpassed the pretended miracles of the magicians. He demonstrated, by experiments, that human industry, with an insight into nature, can produce effects, which they, with all their charms, forceries, and invocation of demons, are unable to imitate. He very easily, and with admirable ingenuity, exposes the monstrous and hurtful superstitions, deliriums, and enthusiasms of the times in which he lived. He very judiciously and religiously distinguishes between the sacred mysteries of piety, and the ridiculous chimeras and inventions of an unsettled brain; between the corruptible principles of the body, and the celestial origin of the soul; between nature and God. He points out with equal sagacity and truth, the folly of the blind superstition of his contemporaries. "Admiration, says he, the parent of magic, is the offspring of ignorance, begot by a vitiated imagination. When weak and ignorant minds perceive an effect, whose cause is hid far in the dark, they presently have recourse to something supernatural to solve the difficulty, and fancy it the production of some magical power." He adds, "there is no such thing really as magic, unless by that word be meant a knowledge of the properties of bodies, and the methods of nature, by an observance and application of which many things, even much more surprising than magic, can be effected."

Nevertheless Francis Bacon was accused and found guilty of having dealings with the devil, was excommunicated by the pope, and for ten years kept in close confinement.

By an attentive perusal of his works, the reader will be astonished to find, that this great luminary, at so distant a period as the thirteenth century, understood not only chemistry, and really was the inventor of gunpowder * and phosphorus, but that he also was acquainted with the use and art of making convex and concave glasses, the camera obscura, burning glasses, telescopes, and contrived something like an air pump; and he mentions himself, "that in the space of twenty years study of nature, in the purchase of instruments, and scarce books, he spent upwards of two thousand pounds;" a vast sum in those days. His writings are equally elegant and nervous.

We will not tire the reader with tracing the progress of chemistry through the dark and fabulous ages of chemistry: but commence at that time when alchemists gave up their golden dreams, and turned their attention to improve by this art the science of medicine.

* Speaking of this discovery, Friar Bacon says, if you mix sulphur and nitre with a third substance, which I will not name from the dangerous uses it may be put to, an explosive powder may be formed, &c.

BASIL VALENTINE seems to have been the first who employed *antimony*. He was a Benedictine monk, and flourished about the fifteenth century. It is reported of him, that having thrown away some antimony, he noticed the swine, who accidentally had eaten it, purged greatly, and, to his no great astonishment, afterwards grew extremely fat. He began immediately to employ it as a medicine, and shortly after published his *Currus Triumphalis Antimonii* (the Triumphal Car of Antimony), where he highly extols the virtues of this mineral, and its preparations, for the cure of an infinite number of diseases. This remedy, however, was looked upon, even in his time, as an highly pernicious poison, and Jacob Grevinus published a treatise against it, in which he advises the magistrates to prohibit its sale, as they had done that of quicksilver and orpiment. *Basil Valentine.*

The doctrines of Galen, which were spread over Europe, had taken such firm root in the 16th century, that they seemed to defy all opposition. The remedies invented by chemical operations were at that time only administered by men in the lowest condition of life, men without science, without industry, and without honour. At length, however, PARACELSUS appeared. He does not seem to have studied physic in any of the established schools; but while he travelled in different countries he picked up remedies from all sorts of people. *Paracelsus.*

ple, and particularly from the chemists of those days. From these he learned the use of mercury and antimony, and from some hardy empirics the use of opium. When returning home from his travels he determined upon following his father's profession, which was that of physic, and by these remedies he was able to cure many diseases that baffled the inert remedies of the Galenists; and being of a bold and boastful disposition, he made the most of these cures; while, at the same time, the partiality of mankind to novelty soon contributed to give him fame. He was so far more fortunate than other chemical practitioners that he obtained the professor's chair at the university of Basil. In this new situation he attempted a system of physic, blended with the most extravagant and visionary doctrines, supported and covered by a great deal of new and unmeaning jargon of his own. His lectures were chiefly employed in recommending his own chemical remedies, and declaiming in the most outrageous manner against the regular practitioners. He went even so far as publicly to burn the works of the Greek physicians; and he insolently told the physicians of Basil, that the very down of his bald pate had more knowledge than all their writers, the buckles of his shoes more learning than Galen or Avicenna, and his beard more sense than all the universities together.

He not only taught the pretended and imaginary

ginary agreement betwixt the principal parts of man's body with the planets; as of the heart with the Sun, of the brain with the Moon, of the spleen with Saturn, of the lungs with Mercury, the kidneys with Venus, the liver with Jupiter, and the gall with Mars; and the agreement of the seven metals to disorders of these parts as they agree with the seven planets, the power of vigils, incantations, &c. but also added to these absurdities animal magnetism, using the hand, a doctrine which has made so much noise in our own time*. He also had a panacea against all disorders,

* The introduction of this scheme in France was undoubtedly with a view to throw ridicule on the *Chylique religion*. The professors of this art pretended impiously, that by faith they could obtain of God power to work miracles as our Saviour did. In the lectures of D'Menadue, published after his demise, he says, that by faith he has broken the stone in the bladder into pieces, and to assist his faith, his hands must work at the part, representing the action of breaking, a tooth in this way can be extracted, and at any distance, &c. He calls God to witness his sincere contrition of his possessing this power, through Jesus Christ; yet he was universally known to be a deist. Opinus quitted Paracelsus from an impious jest on our Saviour, and he was obliged to leave his country for speaking words tending to sedition. I am inclined to think, that some of the learned of days of yore wished to overturn the systems of government then established, and wrote many books, darkly introducing their subversive plans; and whatever is affirmed of metals, chiefly relates to the refining of man, which is the true key to interpret their mysterious sayings. Barruel
VOL. I. asserts

orders, and boasted that he possessed drugs that could prolong life to any period.

It seldom happens that a man of but common abilities, and in the most retired scenes of life, observes such a strict uniformity of conduct, as not to afford prejudice and partiality sufficient materials for drawing his character in different colours; but such a great and irregular genius as Paracelsus could not fail of becoming alike the subject of extremes of panegyric and of satire. He has accordingly been esteemed by some a second *Æsculapius*; and others have thought that he was possessed of more impudence than merit, and that his being spoken of, was more owing to the brutal singularity of his conduct, than to the cures he performed.

But in whatever estimation the merit of Paracelsus as a chemist or physician be held, certain it is that he formed a sect of practitioners, who appeared in opposition to the established schools, which were then entirely followers of Galen, and these two adverse parties agitated Europe for more than five hundred years.

asserts that the *Encyclopedia* of the French was established for this purpose. So artfully was it contrived, that whenever the subject of religion was treated, the end always referred to the words prejudice, or superstition, and under the mask of refuting dangerous errors, the readers, feeling the weakness of the arguments used, were silently brought over to the other side. Gibbon employs the same dangerous weapon in his *Roman History*; and Hume does the same in his *Essay*.

VAN HELMONT flourished about ninety years *VanHelm* after Paracelsus. He was born of a noble family at Brussels, and medicine in those days being a profession beneath his rank in life, he gave up his paternal inheritance to his family, and left his country in order to pursue the bent of his genius. Having conceived a violent prejudice against the *Galenical methods* from his own ill success in putting them into practice, and finding *chemistry* productive of so many, and such powerful medicines, he ran counter in every thing to the *Galenic doctrines*, and endeavoured to reduce the whole practice of physic to the principles of chemistry. In the year 1609 he married a very rich lady, after which he gave himself up wholly to chemistry; and although he did not visit any one out, so great was his reputation, and not practising for gain, that he cured, as he assures us, every year, some thousands of sick people. He employed fifty years of his life in assiduously examining the fossil, animal, and vegetable kingdoms.

His skill was so great, and the phænomena his chemistry presented so marvellous, that he was accounted a magician, and thrown into the inquisition: and having with difficulty extricated himself from this abominable charge, he was released, and retired to Holland.

He first gave the name of *gas* to those vapours, which resemble the air we breathe. He observed,
 “ that

“ that some bodies resolve themselves almost entirely into this aeriform substance. Not,” adds he, “ that they are contained in this shape in those bodies from which they are separated; but exist in them in a concrete form, as if fixed or conglutated. He asserts, that 62 pounds of charcoal contain 61 pounds of gas, and only one pound of earth.” The gas which flies off from calcareous earths and metallic bodies, while they effervesce in acids, did not escape his notice: “ the quantity contained in tartar is so great, that it breaks and bursts into shivers the vessels in which it is distilled, if a free egress be not given to it.” He applied this theory to the explanation of some phenomena of the animal economy. It is to this effluvium that Van Helmont attributes the fatal effects of the Grotto Del Cani;—the suffocation of workmen in mines;—the accidents occasioned by the vapour of charcoal;—and that deleterious atmosphere which is breathed in cellars, where spirituous liquors are in fermentation. He accounts for several diseases upon this principle, and ascribes the propagation of epidemical disorders to noxious vapours with which the air is sometimes infected.

VAN HELMONT undoubtedly would have made a still greater figure in the world had he forborne running into the notions of Paracelsus, and given less into the superstitions of the times. His reputation

putation has also suffered from his posthumous works. As he perceived his end approaching, he called for his son, and gave him the following charge. "Take all my writings, the crude as well as finished ones, and join them together, and publish them; for so it hath pleased God Almighty, who directs all things for the best." And the son, who in his early youth had ran away from his father to stroll with gipsies, after the father's decease, literally jumbled all the papers together, which had been framing for fifty years, and then left the impression wholly to the printer without the smallest correction.

Nothing but success could shake off the torpor or vanquish the bigotry of the Galenists. These at last finding their throne totter, called in the aid of the secular power, and employed it to crush their adversaries. In France antimony was prohibited: but in Germany the chemists prevailed, and the Galenists were obliged sometimes to have recourse to the remedies of the chemists, when SENNERTUS, one of the most eminent of the Galenists in Germany, endeavoured to reconcile the two opposing parties.

Sennertus.

Very early in the seventeenth century, Sir THEODORE MAYERNE, who as a chemical physician had been much opposed and oppressed by the Galenists of France, was called over into England, where he was appointed first physician to the king, and continued to hold that office for

Sir Theodore Mayerne.

more than thirty years after. His theory and his prescriptions were like those of the Galenists; but he was at the same time a great favourer of chemical medicines, and particularly of antimony; the medicine, with regard to which the two sects were most especially divided. It does not however appear, that he met with any violent opposition from the physicians in England: but, on the contrary, we find him becoming a member of, and acquiring great authority in, the London college. It is probable that his great credit put an end in England to all distinction between the Galenic and chemical practitioners; and, as in the year 1666, the faculty of Paris rescinded their arret forbidding the use of antimony, the odious distinction between the Galenists and chemists gradually diminished.

I shall not presume to decide which of the two great branches of natural philosophy contributes most to the use and the ornament of life; but I think it natural that the mechanical department, where palpable masses of matter are brought into action, and motion is visible in its progress, should sooner advance towards perfection than the chemical, where effects are produced by the insensible movements of imperceptible particles. It seems therefore to have its foundation in the order of things, says Dr. Beddoes, that the philosophers of the preceding age should have been employed chiefly by astronomers and mechanics,
and

and those of the present by *chemistry*. Yet if the rule be at all just, what a violent exception,—suffer me to repeat it,—have we in the instance of our own countryman Dr. HOOK, who si- Hook, lently, and unperceived, discovered, if not the whole sum and substance, yet certainly many of those splendid facts which adorn the writings of Priestley, Cavendish, Scheele, Lavoisier, and other philosophers of the present day.

“ From the experiment of charring of wood” (which is done by putting it into a crucible, pot, or any other vessel that will endure to be made red-hot in the fire without breaking, and then covering it over with sand, so as to prevent the access of air, and continuing it in a strong heat for an hour or more, according to the size of the body to be charred), “ seeing
 “ that, notwithstanding the great heat, and the
 “ duration of it, the solid parts of the wood re-
 “ main undissipated whilst they are preserved
 “ from the free access of air, we may learn,” says he, “ *what has not, that I know of, been
 “ published or printed, nay, not so much as thought
 “ of by any* ; and that, in short, is this :

1st. “ That the *air* in which we live, move,
 “ and breathe, that this air is the menstruum,
 “ or universal dissolvent of all inflammable
 “ bodies.

2d. “ That this action it performs not until
 “ the body be first sufficiently heated.

3dly.

3d. " That this action of dissolution produces or generates a very great *heat*, or what we call fire.

4th. " That from this action *light* is also produced.

5th. " That these phænomena do not arise from the air itself considered as an element, but from *that part* of the air which is inherent in it, and is *like*, if not the *very same*, as *that* which is *fixed* in *salt-petre*, which may, I think, most evidently be demonstrated by a multitude of experiments made by salt-petre.

6th. " That by this dissolution the inflammable body mixing with the nitro-aerial part of the air, becomes a new kind of air, just as metal-line or other bodies, dissolved in any menstruum, does the motions and progress of that menstruum, until it be precipitated.

" This *theory* of mine," he continues, " does so exactly agree with all the phænomena of fire, and so genuinely explicates each particular circumstance, as the production of *heat* and *light*, and the *disappearance* of the *burning body*, that it is more than probable that this *cause* which I have assigned is the true, adequate, real, and only cause of those phænomena. As the idea is *entirely new*, I will proceed a little further.

7th. " The dissolving part of the air is but a small part of the whole air, and resembles those

“ those acid menstruum containing other parts
 “ besides the acidifying principle, therefore they
 “ are soon glutted and can dissolve no more :
 “ and therefore unless some fresh part of the
 “ menstruum be applied to the body to be dis-
 “ solved, the action ceases, and the body ceases
 “ to be dissolved ; saltpetre, on the other hand,
 “ being replete with these dissolving particles,
 “ hence the dissolution of inflammable bodies
 “ will be very quick and violent, therefore it is
 “ observable, that, as in other solutions, if a co-
 “ pious and quick supply of fresh menstruum,
 “ though but weak, be poured on, or applied to
 “ the dissoluble body, it quickly consumes it ;
 “ so this menstruum of air, if by bellows, or
 “ any other such contrivance, it be copiously ap-
 “ plied to the shining body, is found to dis-
 “ solve it as soon as the menstruum of burning
 “ nitre.”

“ This theory of *mine*,” he again repeats it,
 “ of the action of air, and of that particular
 “ part, which I would call nitro-aerial, I have en-
 “ deavoured to raise from an infinite number of
 “ observations and experiments, the process of
 “ which would be too long to be here inserted,
 “ (he means in his *micrographia* published in
 “ 1664), and will perhaps another time afford
 “ matter copious enough for a much larger dis-
 “ course, the air being a subject which, (though
 “ all the world has hitherto lived and breathed

" in, and has yet been so little truly examined
 " or explained, that a diligent enquirer will be
 " able to find but very little information from
 " what has been written of it: but being once
 " well understood, it will, I doubt not, enable a
 " man to render an intelligible, nay probable,
 " if not the true reason of all the phænomena of
 " fire, which, as it has been found by writers
 " and philosophers of all ages, is a matter of no
 " small difficulty, as may be sufficiently under-
 " stood by their strange hypotheses, and unintel-
 " ligible solutions of some few phænomena of
 " it, so will it prove a matter of no small con-
 " cern and use in human affairs, as I shall else-
 " where endeavour to manifest when I come to
 " shew the use of air in respiration, and for the
 " preservation of the life, nay for the conserva-
 " tion and restauration of health, as also its uses
 " in chemical, mechanical, and other operations.
 " In this place it becomes me only to hint an
 " hypothesis, which, if God permit me life and
 " opportunity, I may elsewhere prosecute, im-
 " prove, and publish."

Hook, here, reasons perfectly correct, and we
 see him afterwards laying open the thorax of a
 dog, cutting away his ribs and diaphragm, and
 taking off the pericardium, and in that state keep-
 ing him alive before the Royal Society, he blow-
 ing fresh air into his lungs. " It was observed,"
 he remarks, " that as often as we left of blowing,
 " and

“ and suffered the lungs to subside and lie still,
 “ the heart ceased to beat, the animal became
 “ convulsed, but he soon recovered again by re-
 “ newing the blast.”

To prove that the motion of the lungs in breathing was no otherwise necessary to the life of the animal, than as by this motion the lungs receive a constant supply of fresh air, he next pricked all the outer coat of the lungs with the slender point of a sharp penknife, and by a constant blast made by a double pair of bellows, he kept the lungs always distended, supplying the air as fast as it escaped by these apertures, and it was observed that while the blast from the bellows was kept up, the blood flowing from the pricks in the substance of the lungs was of a bright florid colour, that the dog lay still, his eyes were quick, and his heart beat regularly; but that upon leaving off blowing, the blood issuing from the punctures in the lungs was of a dark colour like venal blood, the heart ceased to act, the eyes appeared sunk, and the dog fell into convulsive motion, and he as soon recovered again on renewing the blast, and supplying the lungs with air. It would be foreign to this work to enter more fully into the discoveries of Hook. I can only here express my astonishment, that doctrines like his, confirmed by actual experience, and afterwards improved by Mayow, should be so long lost to the world, and that Dr.

Hunter, a lecturer of great learning, should say, not twelve years ago, that the office of the lungs is unknown to us at the present day, and if we are ever fortunate enough to find this out, we shall surely perceive that this organ is designed from some very important function, as we know the heart, and the other organs possess very important offices. Till of late the whole of chemistry was a mere jargon throughout, and it is curious, that what is called modern improvement should be only the bringing us back to the old beaten path. You see also, what accidents give rise to great things. An apple tossed in the air by a child made Sir Isaac Newton reflect on the reason of its falling, and he made projection and gravity the two principles that unlocked the whole mystery of the motions of the heavenly bodies. So the contemplation of a piece of burnt wood, disclosed the vegetable anatomy, and the true system of chemistry, and the only rational physiology, which now that physicians have turned their attention to it, one day or other promises to be the greatest blessing to the human race.

As I am about to draw the first line of the next sketch, my hand is suspended by the intrusion of a wish, that has often before mixed with my thoughts. It may, perhaps, be not a very interesting talk; but methinks in the superfluity of literary men, one at least might be spared from
other



er services, to explore the ~~dark~~ volumes of
 ent chemistry. Should any one, however,
 able, so far to subdue his disgust, as to define,
 by careful inquiry, what degree of knowledge
 has been acquired from synthesis and analysis
 concerning the constitution of bodies before the
 middle of the last century, I am ready to believe,
 that he would find more credit due to MAYOW,¹
 says Dr. Beddoes, than I dare venture at pre-
 sent to ascribe to him. “* *He was acquainted*
 “*with the composition of the atmosphere,—and per-*
 “*ceived the action of VITAL AIR in almost all*
 “*the wide extent of its influence. He was well*
 “*aware of the cause of the increase of weight in*
 “*metallu cakes; and distinctly asserted, that cer-*
 “*tain bases are rendered acid by the accession of the*
 “*vital air, or what has been since called oxygen,*

* Vide Dr. Beddoes's Analysis of Dr. Mayow's work,
 or Dr. Mayow's Examination of the Claims of the Moderns,
 neither of whom even so much as suspected the priority of
 HOOK, who appears to me (if the discovery was made) to
 have first produced *vital* or *oxygen air* from nitre. Mayow
 in opposition to this, has a chapter purposely to shew that
 there was no air contained in nitre, and has also several
 other allusions against this supposition. Vide note page 289,
 where Mayow's doctrines are concisely exhibited. The
 sentiments of HOOK, who published four years before
 Mayow, are more fully explained in our PHILOSOPHY OF
 BOTANY, OR BOTANICAL EXTRACTS, INCLUDING A
 NEW ILLUSTRATION OF THE SEXUAL SYSTEM OF
 LINNÆUS, to which we refer the reader. It is published
 at present in Numbers, at a Guinea per Number. by
 Symonds, Paternoster-row.

VOL. I.

“or the acidifying principle. His doctrine of respiration is equally just. He has carried on his investigation of this function from the diminution of the air by the breathing of animals, to the change it produces in the blood during its passage through the lungs. The office of the lungs,” says he, “is to separate from the air, and convey to the blood one of its constituent parts.” At the age of twenty-six he formed the peculiar system, continues Dr. Beddoes, which pervades all his works. The Dutch translator of his writings (an honour which they did not obtain from any other people), in the preface to them, affirms, that his philosophy found very little approbation in his own age. So much does the fortune both of truth itself, and of those who speak it, depend upon the disposition of the times in which it is spoken. None indeed smiled upon the fair features of this new-born offspring of science. His name, therefore, as it never was echoed by popular applause, was soon forgotten among men, and his memory obliterated. In the *Biographia Britannica* there is no article appropriated to him. But henceforth, I hope, that when the enthusiasm of an Englishman salutes his country, as

Magna parens frugum !-
Magna virum

Mayow

Mayow will be ranked in the list of her *illustrious*
men.

Boyle was contemporary with Hook and Boyle Mayow; he was in opulent circumstances, and by the agreeableness of his manners, and goodness of his heart, he was peculiarly turned to the study of nature, which pleased him most, and the knowledge of which he cultivated in the way recommended by Lord Bacon *. He was possessed of that penetration and ingenuity of mind, which in experimental philosophy serves to point out the shortest, simplest, and most useful, experiments, and which enabled him to deduce the

The illustrious Bacon formed plans for promoting the sciences in general, and particularly the study of nature. In his comprehensive view of things, he felt that chemistry might turn out one of the most curious and useful branches of natural philosophy. He advised the collecting of facts, and to compare these very maturely and cautiously, in order to discover, if possible, the causes and circumstances upon which they depend, and declares that in this way only could any satisfactory system be produced. *The* *mens*, he thought, were only useful so far as they arose from *experiments* already made, or as they might lead to new ones: for *reasoning* may be considered as the eye of the philosopher, but *experience* is his feeling; and this latter sense ought constantly to rectify the too frequent errors of the former. "If *experiments*, undirected by theory, are "only a blind feeling; *theory*, without experiments, is a deceitful and uncertain vision. —It was thus that this sagacious philosopher directed men in the true path of science, and banished for ever that dark and abstruse philosophy, which was built upon the absurdest conjectures.

most important truths from the most simple and insignificant facts. These are the talents we distinguish in an eminent degree in this philosopher, and for which Sir Isaac Newton was afterwards so remarkable. He examined the prevailing philosophy of the chemists, and exposes its weakness; but he does it with a temper, candour, and modesty, which is truly admirable. What Van Helmont called *gas*, Boyle denominated *artificial air*. Furnished with the new instruments with which he has enriched natural philosophy, he repeated all Van Helmont's experiments in *vacuo*, in condensed air, and in the open air. He made numerous discoveries in this branch of science, and did not fail to notice that there are bodies such as sulphur, camphor, &c. "which *diminish* the volume of air in which they "burn."

The experiments of Van Helmont, of Boyle, and of Mayow, had made it evident that a great quantity of elastic fluid analogous to air was separated from bodies in many operations;—and that also in some other operations a portion of atmospheric air was absorbed; but no one had any idea of the *exact quantities* either produced or absorbed.

Dr. Hales

Dr. HALES was the first person who accomplished this useful purpose. Hence it did not escape this benevolent and indefatigable philosopher, that the quantity of air *absorbed* either by the

the burning of sulphur or of candles, or by the respiration of animals, presented different appearances, according to the quantity of air employed. He discovered that this absorption of air is limited, and that it never proceeded beyond a certain point.

Dr. Hales, in the course of his experiments, has observed also the alternate *production* and *absorption* of air, of which he, however, does not seem to have understood the true cause: the burning of charcoal, and other substances, furnished him with a great *increase* of air, but that *air diminished* daily. This phenomenon depended upon the water which the Doctor used in these experiments: and it will be shewn hereafter, that most of these vapours, and particularly those which we are accustomed to denominate *fixed air*, have a great affinity for water, which is capable of absorbing more than its own bulk of *this air*.

The great number of experiments made by Doctor Hales, which may be found in chap. vi. of his *Vegetable Statics*, comprehends vegetable, animal, and mineral substances. He has examined into the effects of fermentation, chemical dissolutions and combinations, the combustion of bodies, and respiration. Too much cannot be said to induce the reader to peruse his inestimable work. He will find in it a most inexhaustible fund of meditation.

It is in this work, that we perceive the first
traces

traces of the existence of air in those waters, which are called *acidulous*. Dr. Hales has not only remarked that these waters contain four or five times more air than common water, but he also suspected that they owed their remarkable sparkling and briskness to this air.

All the philosophers of his time believed, that fire became fixed, and combined itself with metals, and that to this addition they owed their reduction to a state of calx. Dr. Hales has not only discarded this error, but he has moreover advanced that air contributed to produce that effect, and that to it alone must be attributed the augmentation in the weight of metallic calces. He grounded his opinion chiefly in having obtained from 1922 grains of lead, only 7 cubic inches of air;—whereas an equal quantity of minium afforded him 34 cubic inches*.

Dr. Hales, in summing up his knowledge on this subject, compares the air to “a true Proteus, now fixed, now volatile, entering into the composition of bodies, where it exists in a solid form, deprived of elasticity, and of those properties which formerly distinguished it, adding

* These must have been *oxygen air*. But, I believe, neither Hook, Mayow, or Hales, knew this pure air, however ingeniously they might have reasoned about the nitro aerial particles as a constituent part of the atmosphere, and although each had obtained it distinct, as their several works sufficiently demonstrate.

“ gravity

“ gravity to these bodies, and under certain circumstances alone, capable of recovering its elasticity, and becoming again an elastic and thin fluid, and therefore deserv^{ing} to be adopted among chemical principles, and to possess a rank which has hitherto been denied it.”

The immortal BOERHAAVE, the honour of his country, of his profession, and of his age, next improved upon the experiments of Dr. Hales, by not permitting the factitious airs to have any communication with water. “ It must be acknowledged,” says he, “ that by chemistry we separate from bodies an *elastic vapour*, and consequently that this aerial matter resides in them, but in such a manner as not to have the properties of air, as long as it is combined and united;—but that whenever it is detached, it resumes its former nature, and becomes *true air*, disposed to reunite with other substances again, and remain quiet, but without losing its real nature; for whenever it is freed from the bonds which retain it, it shews itself to be the same body. Nothing can be more certain than this *resolution* and *composition*; and I would have given,” says he, “ many examples of it, had I not lately read Dr. Hales’s celebrated treatise on Vegetable Statics; in the sixth chapter of which book, the author has collected with so much labour and justness, and has related in the best possible order, the experiments which
“ have

“ have been made on this subject, so that he has
 “ exhausted the subject. To these I refer my
 “ readers, and they will see how ART has arrived
 “ at the power of *unveiling* NATURE.”

Hitherto chemistry, though it was much advanced, had been treated only in a desultory manner. A great number of facts were discovered; but none had attempted to generalize them, and form a system; and though many particulars were known, yet the science itself was not in existence.

Excerpt. The illustrious BECHER first began to collate, examine, and compare, the immense store of chemical facts, and observe their relations. This man, whose genius equalled his knowledge, saw, with a single glance, the immense multitude of chemical phenomena. He invented a *theory* that soon obtained credit all over Europe. He was invited to Vienna, where he contributed to the establishment of several manufactures, a chamber of commerce, and an India company, but the jealousy of the ministry finally accomplished both his disgrace and ruin. He was not less unfortunate at Mentz, Munich, and Wurtzburg; which determined him to go to Haeilem, where he invented a machine for working a great quantity of silk in a little time and with few hands; but new disgraces and misfortunes made him retire to England, and he died in London in 1682, at the age of 57, of a broken heart.

The

The theory invented by Becher was adopted *Stahl.* and commented upon by STAHL, principal physician to the king of Prussia. Born, as Becher was, with a strong passion for chemistry, which shewed itself in its early youth, he inherited a genius equal to that of Becher. His imagination was as lively, as brilliant, and as active, as that of his predecessor, and he had the advantage of being heard with attention. In the opinion of these two philosophers *fire* enters into the composition of all inflammable bodies, and into metals and most minerals, and in that condensed, compacted, fixed state, it was called PHLOGISTON * (latent fire), to distinguish it from its condition when in a free state.

We behold flame, we see bodies consumed, we feel a pleasing, and sometimes a painful sensation, when we approach within the sphere of these phænomena. Now is this fire as much a material body, as a piece of wood, or glass, or stone, or any other substance? If it be, whence does it arise? and what becomes of it?—We neither saw or felt it before the body was kindled; and when the fuel is consumed, it no longer appears.—In answer to these questions Becher and Stahl tells us, “ that *fire*, or PHLOGISTON, is actually “ a material body, and liable to be modified by

*71 D. 7r na
of Phlogiston*

* A word derived from the Greek word $\phi\lambda\omega\gamma\epsilon$, *phlogē*, flame, or fire.

“ the influence of circumstances. In bodies liable
 “ to burn, it exists in a latent state :—place them
 “ in circumstances in which combustion is pro-
 “ duced—you then will behold it, perceive it
 “ operate, and feel its influence.—In bodies, as
 “ metals, though you do not perceive the
 “ flame, yet will you discover this principle by
 “ the alteration of their properties. Hence it
 “ is,

*The combus-
 tion of sul-
 phur.*

“ If you take a piece of SULPHUR, and set it
 “ on fire, it will burn entirely away, without leav-
 “ ing any ashes, or yielding any foot. During
 “ the burning of the sulphur, a copious vapour,
 “ powerfully affecting the organs of sight and
 “ smell, and the action of the lungs, is dispersed.
 “ Means have been invented for collecting this
 “ vapour, and it is found to be a very strong acid.
 “ The acid thus procured from the burning of
 “ the sulphur, is incapable of being either burnt
 “ by itself, or of contributing towards the support
 “ of fire in other bodies ; the sulphur from which
 “ it was procured was capable of both : there is a
 “ remarkable difference then, between the acid
 “ procured from the sulphur, and the sulphur it-
 “ self. The acid is not the only constituent part
 “ of the sulphur :—is it not evident then that it
 “ must have contained *something* else, by which it
 “ was rendered capable of combustion ? This
 “ *something* is, from its remarkable property of
 “ rendering a body combustible, denominated
 “ therefore

“ therefore PHLOGISTON, or the *inflammable*
 “ principle.”

“ If you burn CHARCOAL in the open air, and *Of charcoal.*
 “ hold a glass over its flame, you will perceive
 “ that it burns without emitting either any wa-
 “ tery vapour or foety impurity; and nothing
 “ will remain, from a large portion of charcoal,
 “ but a small quantity of white ashes, which are
 “ incapable of any further combustion. The
 “ principle effecting the combustion of the char-
 “ coal, and dispersed by the act of combustion, is
 “ the PHLOGISTON.

“ If you set SPIRITS OF WINE on fire, they *Of spirits of*
 “ will, if pure, burn entirely away; they differ *in*
 “ from charcoal in this, that they emit a vapour :
 “ but they leave no residuum. You may, by
 “ proper vessels, collect the vapour of burning
 “ spirits, and you will find it to be an insipid
 “ water, incapable of combustion. The princi-
 “ ple effecting the combustion of the spirits of
 “ wine, and dispersed by the act of combustion,
 “ is the PHLOGISTON.

“ Some METALLIC SUBSTANCES burn, when *Of metallic*
 “ sufficiently heated, with a flame more bright *bodies.*
 “ than that of spirits of wine or charcoal: others
 “ burn or smother away like rotten wood; and
 “ most of them, when they have been kept in
 “ the open air in a proper degree of heat, lose
 “ their metallic appearance, and are converted
 “ into earth. Thus red lead or minium is the
 “ earth

“ earth procured from the burning of lead; and
 “ putty, such as the polishers of glass and marble
 “ use, is the earth procured from tin. The prin-
 “ ciple effecting the combustion of metallic sub-
 “ stances, and dispersed in the act of combustion,
 “ is PHLOGISTON.

Products of
 combustion.

“ The *acid* of sulphur;—the *ashes* of charcoal;
 “ —the *water* of the *spirit* of wine,—the *earths*
 “ of *metallic substances*, are utterly incapable of
 “ combustion: their respective differences from
 “ SULPHUR, CHARCOAL, SPIRITS OF WINE, and
 “ METALLIC SUBSTANCES, with respect not only
 “ to *inflammability*, but to *smell*, *colour*, and *other*
 “ *properties*, are attributed to the PHLOGIS-
 “ TON which is dispersed during the combus-
 “ tion of each of them.”

“ From the ANALYSIS or decomposition of
 “ SULPHUR, we conclude that the constituent
 “ parts of sulphur are two—an *acid* which may
 “ be collected; and an INFLAMMABLE
 “ PRINCIPLE which is dispersed. The reader
 “ will wish to see this ANALYSIS confirmed by
 “ synthesis, that is, in common language, he will
 “ wish to see sulphur actually made by combin-
 “ ing its *acid* with the *inflammable principle*.”

Sulphur ob-
 tained from
 nitrolic acid
 by means of
 charcoal

“ As this *inflammable principle* cannot be ob-
 “ tained in a palpable form separate from all
 “ other bodies, the only method by which we
 “ can attempt to unite it with the acid of sulphur,
 “ must be by presenting to that acid some sub-
 “ stance

stance in which it is contained.—Charcoal is
 “ such a substance, and by distilling powdered
 “ charcoal and the acid of sulphur together, we
 “ can produce undoubted sulphur. This sulphur
 “ is formed from the union of the acid with the
 “ PHLOGISTON; and the charcoal may be
 “ by this means so entirely robbed of its PHLO-
 “ GISTON, that it be reduced to the state it is
 “ found after complete combustion in the open
 “ air.”

“ Spirits of wine, we have said, consists of *By J. is of*
 “ PHLOGISTON united with *water*:—and if *20 m.*
 “ we distil spirits of wine and the acid of sulphur
 “ mixed together we shall obtain a pure, yellow
 “ sulphur, in no way to be distinguished from
 “ common sulphur.

“ But one of the shortest and most obvious
 “ ways of illustrating both the composition of
 “ sulphur and PHLOGISTON of metallic sub-
 “ stances is the following.—Upon melted lead
 “ pour the acid of sulphur, collect the vapour
 “ which will arise, by holding a very large glass
 “ or other vessel over the melted lead, and you
 “ will, as soon as the vapour is condensed, ob-
 “ serve several filaments of sulphur sticking to
 “ the sides of the glass. Here, when the lead is
 “ in a state of strong fusion, its PHLOGISTON
 “ is in a state of dispersion; and the acid of sul-
 “ phur instantaneously unites itself with this *phlo-*
 “ *giston*, and forms sulphur.

" I will in this place, by way of further illus-
 " tration of the doctrine of PHLOGISTON,
 " add a word or two concerning the necessity of
 " its union with a metallic earth, in order to con-
 " stitute a metal.

" Lead, it has been observed, when melted in
 " a strong fire, burns away like rotten wood; all
 " its properties as a metal are destroyed, and it
 " is reduced to ashes.—If you expose the ashes
 " of lead to a strong fire, they will melt; but the
 " melted substance will not be a metal, it will be
 " a yellow or orange-coloured glass.—If you
 " pound this glass, and mix it with charcoal dust,
 " or if you mix the ashes of the lead with char-
 " coal dust, and expose either mixture to a melt-
 " ing heat, you will obtain, not a glass, but a *me-*
 " *tal*, in weight, colour, consistency, and every
 " other property, the same as lead.

" This operation, by which a metallic earth is
 " restored to its metallic form, is called reduc-
 " tion. The ashes of lead melted without char-
 " coal is *glass*;—the ashes of lead melted with
 " charcoal becomes a *metal*; the charcoal must
 " then have communicated SOMETHING to
 " the ashes of lead, by which they are changed
 " from a *glass* to a metal.

" Charcoal consists of two things, of ashes,
 " and of PHLOGISTON; the ashes of char-
 " coal, though united with the ashes of lead,
 " would only produce *glass*; it must therefore be
 " the

“ the other constituent part of charcoal, or PHLOGISTON, which is communicated to the ashes of lead, and by an union with which the ashes are restored to their metallic form.”

“ The ashes of lead we see then can never be reduced to their metallic form, without their being united with some matter containing PHLOGISTON: and they may be reduced to their metallic form, by being united with *any* substance containing PHLOGISTON in a proper state, whether that substance be derived from the animal, vegetable, or mineral kingdom (for tallow, or iron filings, may be substituted with success in the room of charcoal, in the experiment of reducing the lead); and thence we conclude, not only that PHLOGISTON is a necessary part of a metal, but that it has *an identity* belonging to it, from *whatever substance* it be extracted*.”

It had long been observed, that certain substances, such as *marble, chalk, and limestone*, effervesced with acids,—that these substances were insoluble in water; they were soft to the touch and inoffensive:—But when treated with fire they assumed directly contrary properties, not effervescing with acids;—being easily dissolved by,

*They do not
if present
chemically*

* A complete refutation of the doctrine of phlogiston is given at page 248, it being necessary first to give the outline of the antiphlogistic doctrine.

water so as to form a transparent liquor;—and lastly, they were rendered so caustic as to corrode all animal and vegetable substances. These curious phenomena had not escaped the notice of attentive observers of former times; but the honour of first satisfactorily explaining the true cause of these events seemed reserved for the illustrious professor of chemistry at Edinburgh,

Dr. Black.

Dr. Black. He discovered, that by the process of fire, these substances lost half their former weight, and when treated with acids the compound weighed lighter than before. *Something* therefore was lost. In a treatise, which indeed is a fine specimen of the best method of investigating and demonstrating chemical truths, he ascertained, "*what this SOMETHING was,*" and proved it to be a permanently elastic fluid, which he therefore denominated FIXED AIR, deprived of which the residue was caustic or *quick-lime*—having those properties first enumerated. Dr. Rutherford extended this inquiry, and determined the difference betwixt fixed, and azotic, airs.

Dr. Rutherford.

Hitherto the existence of *fixed air*, and its combination with bodies was a physical opinion, and no physiologist since Van Helmont had adopted it, when the amiable and learned Macbride, professor of physic at Dublin, examined into the medicinal properties of *this air*, and established

Dr. Macbride.

established by the most decisive experiments, its *antiseptic properties*. He ascertained, that flesh which is half putrid, having lost a portion of the *fixed air* which enters into its composition, may recover its former sweetness, by restoring to it its *fixed air*; to produce which effect, it will be sufficient to expose it to the vapours of any fermenting substance, or rather to a current of *fixed air* from an effervescing mixture.

Soon after the publication of Dr. Macbride's treatise, the Hon. Mr. Cavendish communicated to the Royal Society some new experiments confirming the doctrines of these two eminent professors. He further shewed that water is capable of absorbing a volume of *fixed air* more than equal to itself; that this quantity is proportionably greater as the water is colder, and is compressed by a heavier atmosphere; that water thus impregnated with fixed air has all the acidulous and spirituous taste of Seltzar water. Mr. Cavendish determined the quantities of fixed and inflammable gases obtained from different substances: he ascertained their specific gravities: and introduced, or at least set the example, by his accurate mode of experimenting, of establishing a complete system of *pneumatic chemistry*.

Mr. Lane discovered that water impregnated with *fixed air* has the property of dissolving al-

*Tb 1st
abl Mr C
wci 1st ju*

Mr. Lane.

most all metals, and especially iron and zinc; a very small quantity of these metals being sufficient to communicate to water their taste and virtues.

Dr Priestley. Soon after Dr. Priestley entered upon his career, and proceeded with such rapidity of success, that he attracted the attention of philosophers of all nations to these and similar objects, and excited their emulation in the same pursuit; and thereby he has given rise to such auspicious consequences in chemistry, that his entry into this branch of experimental philosophy will be ever considered as an æra in the annals of chemistry.

It is impossible to compress his numerous discoveries in the limits of a few pages. They fill up six volumes; and as the knowledge of the *permanently elastic fluids* is the most important part of chemistry, and has in a manner given to this science an entirely *new appearance*, I would therefore recommend the reader to a careful study of the whole of his incomparable and entertaining works. I shall therefore here confine myself solely to the account he gives us of his discovery of *vital air*, which he denominates *dephlogisticated air*.

Of the discovery of vital air.

On the 1st of August, 1774, I endeavoured, says this illustrious philosopher, to extract air from *mercurius calcinatus per se*, and I presently found that, by means of a very large burning-
glass.

glass, an *aerial fluid* was expelled very readily. Having got three or four times as much as the bulk of the materials, I admitted water to it, and found it was not fixed air, because water did not absorb it. But what surprised me, exceedingly was, "that when a candle was put into this newly acquired air, the flame, besides being larger, burnt with considerable more splendour, and heat, than in common air; and a piece of burnt wood that had any redness in it, was rekindled and burnt away very fast, resembling by its crackling noise paper that had been dipped in a solution of nitre."

I extracted, he adds, in the same way, a quantity of air, with the very same property, from the common *red precipitate*, which had been produced by a solution of mercury in spirit of nitre, and hence I concluded that this peculiar property was derived in both instances from *nitrous particles*. I even thought that what was usually sold as the *mercurius calcinatus per se* was contaminated with *nitrous acid*. However, upon mentioning this suspicion to Mr. Waltire, he furnished me with some, which he assured me was genuine. This being treated in the same manner as the former, only by a longer continuance of heat, I extracted much more air from it than from the other. This experiment might have satisfied any other; but being at Paris in the October following, and knowing that there were several very

eminent chemists in that place, I did not omit the opportunity to get an ounce of *mercurius calcinatus* prepared by Mons. Cadet; of the genuineness of which there could not possibly be any suspicion; and at the same time I frequently mentioned my surprise at the kind of air I had got from this preparation to Mons. Lavoisier, and several other philosophers who honoured me with their notice in that city.

At the same time that I had obtained the air above described from the *mercurius calcinatus* and the red precipitate, I also procured some of the same kind from minium, or red lead. As I never made the least secret of any thing that I observed, I mentioned this experiment also, to all my philosophic acquaintance at Paris, and elsewhere; having no idea at that time to what these remarkable facts would lead.

The French chemists, who had been inattentive to the admirable discoveries of Dr. Black and Mr. Cavendish, were roused by the striking phenomena which Dr. Priestley's discoveries presented. Their minds being prepared by the active and enlightened genius of the age, the spark was no sooner struck, than the most brilliant effects began to shew themselves along the French meridian. Never was the passion for novelty, now concurring with philosophical ardour, more happily exerted among the philosophers of that lively nation, than in the cultivation
of

* of this ample field of knowledge, which had been first explored, and the richness of the soil demonstrated principally by our illustrious countrymen, Mayow, Boyle, Hales, Black, Cavendish, and Priestley; of the three last of whom I shall be joined, by every lover of science, in the wish,

Sero in cœlum redeant.

But the efforts of Dr. Priestley's discoveries were not confined to France. They passed to every country in Europe, and across the Atlantic. More extensive in their influence than the commotions of Calabria, they spread their better agitations, particularly into Germany, Italy, and Sweden; in which last kingdom they met the congenial spirit of two illustrious chemists, Bergman and Scheele; the *former* distinguished by the order, precision, and various abilities with which he improved chemistry; and the *other* by so numerous a train of discoveries as could only occur to a man who, like Scheele, joined to a profound knowledge of chemistry, an intuitive genius, and a laborious zeal. The discovery of *vital air*, the pride, as it is called, of modern philosophy, had slumbered for more than a century, when this illustrious philosopher drew it forth from nitre, and a variety of other substances, and called it *empyrean air*, a word which implies,

implies, "*formed of the element of fire,*" or "*an air pure in the extreme.*"

It is singularly curious, that two philosophers of the present day should both, and at the same time, and by different processes, discover this *wonderful gas*, which has thrown light on the whole œconomy of nature, and both of them ignorant of the prior claim of Hook and Mayow, of whose claim they certainly knew nothing. Dr. Priestley and Mr. Scheele however paid the debt to humanity, being biaſſed by the prevailing opinion of *phlogiston*, in which they were seconded by the ingenious and laborious Kirwan, who wrote a book expressly to support the *old theory*, as it is called.

Kirwan.

At this time the *new*, or *anti-phlogistic theory* sprang up in France. It derived its chief origin from Lavoisier, who had soon the felicity of being joined by Berthollet, Morveau, Adet, Hazenfratz, De la Place, Monge, Chaptal, Fourcroy, and others, who have united their labours in establishing this *new system*, which, from such a combination of talents, could not fail of being exhibited with every advantage, and of fixing the attention of the philosophic world.

Lavoisier.

At present
the phlogistics
are put on
the combustion
"

I. These chemists contend, that although the atmosphere is a vast laboratory, in which nature operates immense analyses, solutions, precipitations, and

and combinations, although it is the grand receiver, in which all the attenuated and volatilized productions of terrestrial bodies are received, mingled, agitated, combined, and separated, nevertheless the *atmospheric air* is the same with regard to its *qualities*, being decidedly marked by its *two properties* of supporting respiration and combustion.

II. A combustible body cannot burn without the contact of atmospheric air. Thus combustion cannot take place in vacuum. *The proof of it is.*

III. A combustible body cannot burn in a given quantity of atmospheric air, beyond a certain period. An hundred pints of this air contain only 27 pints capable of supporting combustion; when these 27 pints have been united to the combustible body, the combustion ceases, as the other 73 pints cannot in any way contribute to its support. *Combustion is limited by the quantity of air.*

IV. Hence it appears, that *atmospheric air* is a compound of *two different airs*;—of these two substances, *one* supports respiration and combustion; this is termed VITAL AIR: the *other* is the reverse of it, and is called AZOTIC AIR. *Combustion gives the analysis of common air.*

V. Thus a burning body in the air effects a *Vital air* real *union with*

the combustibility of a body. real analysis of this fluid. It separates from it and absorbs the VITAL AIR, which augments the weight, and changes the nature of the burning body.

The qualities of the residuary air. VI. The AZOTIC AIR which remains is lighter than the atmospheric air, extinguishes bodies in combustion, and kills animals.

The true definition of combustion. VII. Combustion then consists in the *fixation* and *absorption* of VITAL AIR by the combustible body, by a true decomposition of the atmospheric air.

The qualities of the combustible body when burnt. VIII. A combustible body which has burnt in atmospheric air, and *absorbed* all the VITAL AIR to which it is capable of uniting, can burn no longer even in a fresh quantity of air: it has become incombustible, and frequently *acid*.

The origin of the term oxygen air. IX. As many bodies by absorbing the VITAL AIR are rendered *acid*, hence the term which it has also received of OXYGEN AIR, or the ACIDIFYING PRINCIPLE.

Of the disengagement of heat and light. X. There is another interesting phænomenon in combustion, which modern chemistry is able to explain; namely, that of the disengagement of *heat* and *light*.

XI. Combustion is not confined to the decomposition of atmospheric air by absorbing one of its principles; for it also *decomposes* the VITAL AIR, by absorbing, fixing, and rendering more or less solid, in the combustible body, the *oxygen*, or base of the vital air, and disengaging the solvent of this base, *caloric*, or *heat*, in greater or less quantity.

*Combustion
also decom-
poses the vi-
tal air.*

XII. It is demonstrated, that the light which constitutes *flame* is contained in the VITAL AIR, of which it is one of the principles; for combustible bodies afford much more flame when they burn in vital air, than in atmospheric air.

*Light and
heat compo-
nent parts of
vital air.*

XIII. Hence it follows, that when we burn a *combustible* body, in order to procure *heat* or *light*, as we do to mitigate the rigours of winter, or to chase away the darkness of the evening, we obtain these from the *air* itself in which they enter as principles.

Accessory.

XIV. Now as VITAL AIR only serves to support combustion, it is easy to conceive, that a very combustible body, capable of absorbing the whole of the VITAL AIR, may be employed to determine the proportion of the vital and azotic airs in common air: thus phosphorus and nitrous air are now used for the purpose of *eudiometry*,

*Now the
quantity of
common air
may be ascer-
tained.*

metry, or to discover the purity of the air; that is to say, the proportion of the VITAL AIR which it contains.

*Why we
should appreciate
different
combustible
bodies*

XV. Combustible bodies are too various, numerous, and important in the phænomena they exhibit, and the combinations they are incessantly entering into with each other and with the air, not to excite us to examine them with care, and endeavour accurately to ascertain their properties and specific characters.

*The diamond
is a combust-
ible body.*

XVI. The diamond is the hardest of all the bodies we know. It is very remarkable for the power with which it refracts and decomposes light, from which the immortal Newton rightly conjectured it was combustible, and this is found actually to be the case.

*M tells us to
omit oxygen
the base of
vital air.*

XVII. Though there are various circumstances under which metals may be united with OXYGEN, they may be reduced to three.

1. The first is the contact of *air*.
2. The second is owing to the decomposition of *water*, which we shall presently shew is composed principally of oxygen.
3. The third depends on *acids*.

In this triple view the oxydation and dissolution of metals are here to be considered.

XVIII. All metals heated in the air, and raised to a temperature more or less high, are susceptible of burning with a vivid flame, great heat, and a true deflagration, in which process they absorb OXYGEN. Those that oxydate slowly, and without perceptible inflammation, equally disengage *light* and *caloric* from the vital air, but in so small a quantity at a time, that they are not rendered sensible to our organs.

Metals are to be effused combustible bodies.

XIX. All metals increase their weight during this operation, which does not take place without the contact of air, and consequently they absorb a principle, the OXYGEN of the atmosphere, without losing any one.

Metals during combustion increase in weight by absorbing oxygen.

Neither the name of calcination which was given to this phænomenon, nor that of metallic calces, can be retained; but instead of these have been substituted the terms of combustion and oxydation for the operation, and of metallic oxyds to denote the metals thus burnt or oxydated.

XX. Elevation of temperature favours the absorption of the OXYGEN of the atmosphere by metals, and renders the combination of this principle with these combustible bodies more considerable.

Heat increases this absorption.

XXI. While ~~there~~ are some metals which never

Metals differ in this respect.

ver burn in the air, except at a high temperature, as gold, silver, and platinum, there are others which burn at all temperatures, even the lowest, and with great promptitude, as manganese. Some, as iron, copper, lead, burn slowly, and in the course of some months, in the air, even though cold.

Metals absorb different quantities of oxygen.

XXII. Not only do all metals compared with each other absorb different quantities of OXYGEN to saturate them in their combustion by the contact of air, but each metal considered separately absorbs different proportions, and stops at various points of *oxydation*, according to the degree of temperature to which it is raised. Thus tin, lead, copper, iron, change colour and assume the tints of the rainbow, at the first degree of fire to which they are exposed in contact with the air: lead first becomes a grey oxyd, next yellow, and lastly red; mercury passes from black to white, from white to yellow, and from yellow to red; iron, at first a black oxyd, becomes next green, then brown, and ultimately white: copper is at first a brown oxyd, from which it changes to blue, and its last degree of oxydation imparts to it a green colour.

The reason why metals exhibit different coloured flames.

XXIII. The colour which metals display in burning, or with which their flame is tinged, appears to be owing to the dissolution of the metallic

tallic molecules in the light that is evolved. Thus copper yields a green flame, &c.

Before we consider the oxydation of metals in water and acids, it may be proper first to notice the composition of these bodies.

XXIV. *Water* is not a simple element, as was formerly supposed. By burning with rapidity a number of combustible bodies, more or less heated, as charcoal, red-hot iron, oil, &c. water is decomposed, yielding to these combustible bodies the OXYGEN it contained.

*Combustible
bodies
rapidly
burning
decompose
it
into oxygen.*

XXV. In proportion as the OXYGEN of the water becomes fixed in the combustible bodies which it burns, its other principle which is dissolved in the caloric forms the INFLAMMABLE AIR which is evolved.

*Hence the
evolution of
its other prin-
ciple hydro-
gen.*

As this second principle is one of the elements of water, it has been called HYDROGEN, and when it is an elastic fluid from its solution in light and caloric, HYDROGEN, or INFLAMMABLE, AIR.

XXVI. Reiterated experiments have proved, that water contains 85 parts in a hundred of OXYGEN, and 15 of HYDROGEN. The recomposition of water, one of the most brilliant discoveries of modern chemistry, which was made by the Honourable Mr. Cavendish, confirms the

*The compo-
sition of water
proved by
analysis.*

analysis of this body: for on uniting by combustion 85 parts of OXYGEN with 15 of HYDROGEN, 100 parts of pure water are obtained.

*Hydrogen air
is always
from the de-
composition of
water.*

XXVII. The HYDROGEN AIR produced in various experiments always originates from water, either in consequence of a preceding decomposition, in which it had been combined in the state of *fixed hydrogen*, with one of the substances employed, or from the decomposition of the water actually taking place in the experiments themselves.

All HYDROGEN therefore proceeds from water, and when it is in the form of *air* it has combined with caloric: and it is easy to conceive how hydrogen, one of the elements of water, acquires levity by participating of the elastic property of caloric: and, in fact, while a cubic foot of water weighs seventy pounds, a cubic foot of pure hydrogen air weighs only sixty-one grains.

*It is aff-
the decompo-
sition of wa-*

XXVIII. The combustible bodies which decompose water, generally speaking, are those which have a greater affinity, or stronger attraction, for oxygen, than hydrogen has: but this attraction is greatly assisted by the presence of caloric, which, as we observed, united with the hydrogen, holding it in solution in the form of gas or air.

XXIX. HY-

XXIX. HYDROGEN GAS carries along with it various substances, either suspended or dissolved in it, according as the bodies are applied to the water from whence it is extricated. From the difference of these adventitious substances which it contains, it *varies* in smell, weight, and inflammability, the colour of the flame it yields, its action on different bodies, and also in the product which it affords in burning. Hence are derived the several species and denominations of inflammable air admitted by authors, of which hydrogen always constitutes the general basis.

The different species of inflammable air.

XXX. To recapitulate. **HYDROGEN** is one of the principles of water. With caloric and light it forms hydrogen air, thirteen times as light as common air, capable of dissolving sulphur, phosphorus, charcoal, oil, &c. and then forming the different species of hydrogen air, formerly called sulphurated, phosphorated, carbonated, oleagenous, inflammable air. It imparts to all the compounds into which it enters, whether they be combustible or not, a considerable refringent power, which property led the sagacious Newton to conjecture, that a combustible substance was contained in water.

The properties of hydrogen.

XXXI. The hydrogen air being thirteen times lighter than common air, it rises above the common air, and to the combustion of this air, by

The cause of the aurora borealis.

means of the electric fluid, arises most probably the phenomenon of the aurora borealis.

*The cause of
detonations.*

XXXII. The disengagement of this principle in the form of gas,* which takes place wherever water is decomposed by a combustible body, is the cause of a great number of detonations and fulminations, which occur in chemical processes.

*Of thunder
and rain.*

XXXIII. It is also probable that atmospheric detonations, claps of thunder, proceed from the hydrogen air inflaming, by means of the electric fluid, in common air; and accordingly they are often succeeded by a torrent of rain.

*Sudden ap-
pearance of
fog.*

XXXIV. When in a clear day a storm or a sudden takes place, and the heavens are overcast, it is probable that this sudden formation of water in the atmosphere, arises from the rapid union of the hydrogen gas and vital air, occasioned by the necessary re-establishment of an equilibrium of electricity between different clouds, or between the clouds and the earth.

*The origin of
acids.*

XXXV. As every acid contains OXYGEN, and loses its acidity exactly* in proportion as it is deprived of this principle, we ought to consider acids as burnt or oxydated substances, which are akin to each other from the presence of this acidifying principle.

XXXVI. Since

XXXVI. Since all acids resemble each other in their taste, their manner of giving a red colour to vegetable substances, their tendency to combine with alkalies, and metallic oxyds, and their property of attracting and being attracted powerfully, it was natural to presume, as Sir Isaac Newton observed, that they likewise resembled each other in their intimate nature, and possessed some homogeneal principle: and chemical analysis has established this as a truth beyond the possibility of a doubt.

*Why acids
have com-
mon prop-
ties.*

XXXVII. The best method of acquiring a knowledge of the nature of acids is by forming them, by composing them, from their constituent parts, in uniting with OXYGEN such substances as are capable of becoming acid by an union with it.

*Method of
investigation.*

XXXVIII. Out of thirty known species of acids, there are but three, strictly speaking, which we can either compose or decompose, so that we are necessarily ignorant of their nature; but there is no reason why we should not regard substances of this kind as accurately discriminated, and contemplate their general properties and compositions.

*Three are
made in this
branch of
science.*

XXXIX. All acids being compounds of OXYGEN with DIFFERENT SUBSTANCES,

*Why acids
are different-
ly character-
ised.*

CES, the *former principle* is the cause of their resemblance and common properties; the *latter*, being different in each, may serve to characterize each in particular. For this reason, those matters which are variable in acids are termed their bases, or acidifiable principles.

Of the common principle and base.

XL. Thus all acids are combinations of bases, or acidifiable substances, different in each species, with oxygen, which is the same in all: whence it follows, that their common properties, their characters as acids, depend on OXYGEN; their particular properties, their specific characters, arise from their bases.

The new nomenclature.

XLI. The word acid, indicating the general and identical nature of these substances, forms their generical name, while the particular name of the bases of each may with propriety designate each particular acid. Thus sulphur is the basis of the acid we call sulphurous, carbon that of the carbonic, and so on.

Metals decompose water.

XLII. Various metals decompose water, and this the more rapidly the higher the temperature is raised. Thus iron decomposes water with the greatest rapidity when much heated, though it requires a considerable time to effect its decomposition at the highest temperature our atmosphere ever attains.

XLIII. Sul-

XLIII. Sulphurous acid, diluted with water, greatly facilitates the decomposition of the aqueous fluid by means of metals, and evolves in this process hydrogen gas; this is eminently the case in the dissolution of iron or zinc by the diluted sulphurous acid.

Sulphurous acid promotes the decomposition of water

XLIV. There are some cases in which the water and the acid are at the same time decomposed by the metal, as in the solution of tin in the nitrous acid. Tin is so greedy of OXYGEN, and requires so large a quantity for its saturation, that after having absorbed that of the nitrous acid, and reduced it to the state of azote, it decomposes likewise the water, and disengages hydrogen. These two principles being separated from their first compounds, unite together, and immediately form ammoniac.

Sometimes acids are also decomposed

XLV. Metallic oxyds have different degrees of affinity with acids; hence some may be employed to decompose combinations of others. Thus several metals, by taking OXYGEN from the others which are dissolved by means of acids, occasion the re-appearance of the dissolved metal. Thus mercury will occasion the re-appearance of silver, copper of mercury, iron of copper, zinc of iron, &c.

The different affinities of several metals have for oxygen

The reduction of metals.

XLVI. The reduction of metals arises from substances which have a greater affinity for OXYGEN than the metallic base, and these combine and form with this principle different compounds. Thus carbon or charcoal added to a metallic oxyd, at a certain temperature, unites with the OXYGEN of the calx, and forms carbonic acid air, or fixed air; and hydrogen air, by uniting with the OXYGEN of a metallic oxyd, or calx, forms water, while the metal is restored to its metallic splendour and its other characteristic properties.

Refutation of the doctrine of Phlogiston.

One may here pause a moment to consider the causes that pervert the understandings of men, and the difficulty there is to root up error when once established.—It is natural in the rudest state of science to consider the changes of property in chemical bodies as resulting from the loss or acquisition of *something*, and, if this could not be demonstrated, to give it some general appellation. Hence the term PHLOGISTON. It was this principle, which escaping from a metal during calcination converted it into a calx, or earthy substance; and it was the union of this principle which rendered the air mephitic. Here the *phlogistians* appealed to the senses.—But when these altered bodies came to be accurately weighed, it was found that 100 pounds of lead converted into minium, or calx of lead, weighed 112 pounds; and when the experiment was performed in close vessels, the volume of air was diminished during

the process; and the air, after the calcination ~~was~~ complete, weighed exactly 12 pounds less than before.—This argument, which shook the very foundation of the *phlogistic doctrine*, the sophistry of men, who wished to indulge their delusion, endeavoured to answer by saying, that gravity was relative; thus a cork which falls to the ground rises in water, and PHLOGISTON having a tendency upwards, buoyed as it were each body in which it entered, and hence, when removed from the metal, its increase of weight, and hence the decrease of weight in the atmospheric air employed in calcination.—When it was observed, that this explanation would not hold in other instances, for when charcoal was burnt there was but a small residuum, and this weighed *lighter* than when it had its phlogiston, and the mephitic air on the contrary *heavier*, “Ah,” say they, “there are difficulties in every science, and we “do not presume to explain every thing;” generally, at the same time, knitting the forehead and walking off.—But the *antiphlogistians* kept on exulting at every interview, and they examined the *mephitic air* from each process, and observed it was sometimes *azotic air*, sometimes when charcoal was used *fixed air*, and sometimes *water*; and when the *mercurius precipitatus per se* was discovered by *Monf. Lavoisier* to give out VITAL AIR which calcined other metals, giving them weight, and that when any residue of this air re-
mained

maintained it was not *mephitic*, and when combined with mephitic air in the proportion of one to four it made common atmospheric air, it was then that the *antiphlogistans* truly triumphed, and the VITAL AIR, which forms a fourth part of our atmosphere, became the universal *Ædipus* that unlocks all the mysteries of chemistry, the *causa sine qua non* of the antiphlogistic school.'

Full establishment
of the new chemistry

The *new doctrines* were combated by Dr. Black for ten years, who finally became a convert to it. Writing to *Lavoisier*, he says, "such is the force of PREJUDICE, that it requires ten years to overcome this hydra, but now I feel the force of truth, and assent to it."—The celebrated *Kirwan* next writes to *Lavoisier*, "that he has renounced his work in favour of the *phlogistic doctrine*, and means himself to refute it." Even Dr. *Priestley* declares, "that he has been more than once upon the point of abandoning the doctrine of *phlogiston*;" and in his sixth volume he actually declares "in favour of the decomposition of water," and adds, "nor shall I feel much reluctance to adopt the *new doctrine*, although I think the chemical phænomena admit of the easiest explanation on the old system."

Respecting the nature of the composition of the air Dr. *Priestley* says, "for my own part I will frankly acknowledge, that at the commencement of the experiments recited, I was so far from having formed any hypothesis that
" led

" led me to the discoveries these produced, that
 " they appeared to me improbable when I heard
 " of them; and when the decisive facts did at
 " length obtrude themselves upon my notice, it
 " was very slowly, and with great hesitation, that
 " I yielded to the evidence of my senses. And
 " yet, when I reconsider the matter, and com-
 " pare my last discoveries relating to the consti-
 " tution of the atmosphere with the first, I see
 " the closest and easiest connexion between them,
 " so as to wonder that I should not have been led
 " immediately from the one to the other. That
 " this was not the case, I attribute to the force
 " of PREJUDICE, which unknown to our-
 " selves, biases not only our judgments, properly
 " so called, but even the perceptions of our
 " senses; for we may take a maxim so strongly
 " for granted, that the plainest evidence of sense
 " will not entirely change, and often hardly mo-
 " dify, our persuasions; and the more ingenious
 " a man is, the more effectually he is entangled
 " in his errors; his ingenuity only helping him
 " to deceive himself by evading the force of
 " truth."

We will not fatigue the reader by entering
 more deeply into the *new* or *antiphlogistic doctrine*
 respecting those bodies which have no vital prin-
 ciple, and which are therefore distinguished as be-
 longing to the mineral kingdom.

The difference between the mineral and vegetable kingdoms.

XLVII. In the *mineral kingdom*, we are justified in referring all the phænomena to the action of external bodies, and the simple law of affinity affords deductions sufficient to account for all its changes. In the *vegetable kingdom*, on the contrary, we are compelled to acknowledge a vital principle which presides over every thing, and performs many chemical processes which we poor mortals attempt in vain to imitate.

Plants are distinguished by possessing a living principle.

XLVIII. That plants have a *living principle* is evident by the motion of the sensitive plant, which we may excite at pleasure; by the spontaneous motion of the *hedyсарum gyrans*; the retraction of the stamina of the *cestus*; the advance of the stamina to the pistillum in other flowers; by the leaves turning to the light; and some plants following the sun; by their closing against rain; by the roots turning out of their direction to plunge themselves into water, or a more favourite soil, &c.

They reproduce their species.

XLIX. The reproduction of *vegetables* is effected in the same manner as that of *animals*; and modern botanists have supported the comparison between these two functions in the most conclusive manner.

Their relation to air.

L. *Vegetables* require the same kind of air as *animals*.

LI. The

LI. The *great difference* which exists between *vegetables* and *animals* is, that the latter *in general* * *They have no locomotive power.* are capable of conveying themselves in search of nourishment; whereas vegetables, being fixed in the same place, are obliged to take up in their own vicinity all such materials as are capable of nourishing them: and nature has therefore provided them with leaves, to extract from the atmosphere the air and water, while the roots extend to a distance in the earth to take firm hold, as well as to imbibe water and the fixed air contained within the bowels of the earth.

* Oysters, muscles, polypi, &c. connect this chain, and seem as it were intermediate links, having no locomotive power.

LAWS OF THE ANIMAL ŒCONOMY.

S E C T. III.

ON STIMULI.

AFTER *astronomy* had shewn, that the immensity of space was filled with innumerable worlds, revolving round innumerable suns; those worlds themselves the centers of others, secondary to them, all attracting, all attracted, enlightened, or receiving light, and at distances unmeasurable, did the immortal Newton disclose to the astonished world *the laws which these obeyed*.

In like manner, after *anatomy* had demonstrated a wonderful complicated structure of the human body, the parts so delicate, and their relations to, and influence upon, each other so immense, has another Newton, as it were, demonstrated, that all these several parts *obey the same great and fundamental laws*.

This was the memorable discovery of the late Dr. Brown, a *noted* author and teacher of physick, as he is styled by Dr. Cullen, whom the prejudice of old age, and the pride of celebrity, conspired

spired from receiving his doctrines and who would fain persuade himself that the author, whom he *notes*, and against whom he protests, was really contemptible. For my part, says the illustrious Dr. Beddoes, I consider Dr. Brown's doctrine of *excitement* as a most perfect specimen of extensive reasoning, truly calculated to afford the fullest satisfaction to a just thinker. He avoids those unmeaning and vague terms, that had before been so much used to shelter ignorance from their employers and from others; he appeals to the phenomena of the living system obvious to the senses; and adopts such principles of reasoning, that if he has not always discovered the truth, he is never forsaken by the spirit of a true philosopher. Dr. Darwin, who is no less eminent as a physician than a poet*, entertains similar sentiments with respect to the *Brunonian doctrine*, and allows his work to be, with a few exceptions, a performance of *great genius*. I do not mean here, however, to defend Dr. Brown's personal conduct, which perhaps more than any thing else caused his doctrines to be condemned unheard, as if the grossness of a man's manners affected the conclusiveness of his arguments. If his imprudence, however, was highly blameable, and his arrogance intolerable, the liberal will allow something

* The celebrated author of *The Botanic Garden, or Loves of the Plants* and of *Zoonomia*.

to the deep consciousness of *neglected merit*, and to the irritating sensations attendant upon *declining health*: and posterity will perhaps reproach an age, in which a man, possessed of powers, *so superior*, and *so nobly exerted*, was brow-beaten, defamed, even driven from his country by shameless persecution *, and left to perish in *London* in extreme penury. But to return to the main object of this part, *the laws of organic life*.

* Thank heaven! such *arts* cannot now prevail. Knowledge and improvement gain ground every day. Men of science, not bred to the profession, have begun to exercise *their own judgment*; and when that comes generally to be the case, *true merit* must be encouraged, many *abstruse* doctrines of old *physicians* will be exploded; and the tyranny of *empty pomp* and *learned mystery* in physic will be driven out of the land, and forced to seek shelter among less cultivated societies of men. *Philosophic instructions* on the important subject of health, delivered in a familiar way, cannot injure in the least *medical men*, who have the high advantage of *experience* together with *education*, for no sober man of common sense will trust the *salvation of his soul* to a *cobbler*, nor employ a *taylor* to defend *his property* in Westminster-hall. I am, therefore, fully persuaded, that when the *thinking part* of the nation are taught the *laws* of the *animal economy*, or *philosophy of medicine*, men in general will feel it their duty to support the *regular faculty*, and will be weaned from being *quacked* by *miscreants*, who are as little qualified to *practise physic*, as a *cobbler* is to preach, or a *taylor* to plead a cause, or a *mender of kettles* to repair (an instrument of far less complicated structure than the human body) your watch.

STIMULI are the *exciters* of *actions* in animated bodies, and are of *two kinds*,

1. *Direct*, producing *tone*, or *strength*, in the *fibre*;—and an *expenditure* of the *irritable principle* :
2. *Indirect*, producing *atony*, or *weakness* in the *fibre*;—and an *increase* of the *irritable principle*.

ACTION, or EXCITEMENT, in animated bodies, is the *retrocession* of the *fibre* upon the application of *stimuli*; and is in *proportion*,

- 1st. To the *strength* of the *fibre*,
 - 2d. The *quantity* of *irritable principle*,
- And 3d. The *degree* of *stimulus* applied.

THE LAWS OF THE ANIMAL ŒCONOMY are *the changes* that the *fibre* and *irritable principle* undergo upon the application of *stimuli*.

The laws of organic life, when fully explained, are so obvious to every thinking mind, that it seems surprising they were not earlier elucidated, and brought forward to solve a number of difficulties respecting health and diseases, and the proper method of preserving the one and removing the other. On account of their great simplicity, and their easy application in medicine,

I durst not, says the learned Dr. Beddoes, at first believe them to be true. They apply equally to the muscular and sentient fibres, which therefore throw much additional light and confirmation on each other.

Every age, every habit, if the excitement by *stimuli* be properly directed, has its due degree of vigour arising from it. *Childhood*, as possessing *abundant excitability*, admits of *moderate stimuli*; with an under proportion, it becomes *languid*; with excess, it speedily feels *oppressed*. In the *middle period of life*, where the *excitability* is in *due power*, a *moderate stimulus* is requisite to stir up all the actions of life. *Old age*, on the contrary, owing to a *deficiency of excitability*, requires a *great deal* of stimulus; it becomes *enfeebled* by too little, and quickly *overset* by more*.

In

* This verifies the old adage, "*Milk is the food of infancy, and wine of old age.*" What calumnies have not been thrown out against John Brown for this doctrine? If *low living* and *starving* are reprobated for the facts and reasons that presently will be assigned, why, therefore, should he be called a friend to *intemperance*? On the contrary, he only approves and tries to adjust the *proper standard*, condemning all *extremes*, and advising the *mean* under which *virtue* takes her post. If he has any way erred in this *difficult* but *honourable attempt*, as he certainly did not err *wilfully*, I know not why he should be held up as a *criminal*, or *censured* with *greater asperity* than the exploded theories of Boerhaave or Cullen. This knowledge will assuredly,

In one word, *excitement*, the effect of *stimulating powers*, when of a *proper degree* and *joined to the person*, constitutes *firm health*; when either *excessive* or *deficient*, proves the occasion of *weakness* and *disease*.

To obtain some conception of the grandeur of this subject, only imagine to yourself, by the *Almighty Fiat*, a stop put to the *movement* of all things. There would no longer be the succession of night and day, the changes of the seasons, the growing of the different productions of the earth, nor wind, nor rain, nor circulation, nor secretion, nor life. On the contrary, *nature* is ever performing her eternal rounds, and, obedient to the *great command*, we pass onwards from a specklike beginning to manhood, and from man-

as Dr. Beddoes justly observes, become a part, and the most important part, of education. Physiological ignorance is the most abundant source of *our sufferings*; every person *accustomed to the sick*, must have heard them deplore *their ignorance* of the *necessary consequences* of *those practices*, by which their *health* has been *destroyed*; and when men shall be deeply convinced, that the *eternal laws of nature* have connected *pain* and *decrepitude* with *one mode of life*, and *health* and *vigour* with *another*, they will avoid the *former*, and adhere to the *latter*. And as actions are often named immoral from their effects, self love, or the enjoyment of health, are *so far* the same. Nor is this sort of morality likely to terminate in itself; but the habit of acting with thought and resolution, will *extend* from the selfish to the social actions, and regulate the whole tenour of life.

hood to old age. While we are thus running our course of life, every thing within us is in a *constant movement*. If we have existed even but a few years, the blood has been circulating from the heart through the lungs, and the body, *countless times*; and the stomach and intestines have been performing *innumerable* wave-like motions.

We have before shewn that the *motion* of the heart and arteries, the stomach and intestines, depended on the *retrocession* of *irritable fibres* from *certain stimuli*; in the following sections we shall consider the *effects of different stimuli* * on the human body.

* As Heat, Light, Air, Food, Exercise, &c.

LAW I.

A due Excitement of the Fibrous
and Nervous Systems is necessary
for the Maintenance of Health
and Vigour.

OUR
RELATIONSHIP
TO
AIR.

INTRODUCTION.

SECT. IV.

OF CHEMICAL ATTRACTION.

PREVIOUS to our explaining the laws of *chemical attraction*, we should first briefly contemplate the *attraction of gravitation*, or that power which draws bodies to the centre of the earth. It is from this law that different bodies in the creation assume their proper station, heavy bodies descend, and light ones ascend; by this, projectiles are directed, vapours and exhalations rise, and rains fall; by this, rivers glide, the air presses, and oceans swell. If we extend our mind, we shall perceive that this law also governs all the planetary worlds. Projected by the almighty *fiat*, they would roll on through the infinitude of space in straight lines, but the central suns overcoming in part this power by *the law of gravity*, hence each planet forms his own respective circle:
but

but *chemical attraction*, or the *attraction of cohesion*, we are about to consider, is that principle which joins and combines into little systems those several and distinct corpuscles which form different substances. It is that *attractive force* by which they tend mutually towards each other, which force only exists in the very point of close contact, at little distances is less, and at a little further distance is quite insensible.

The *attraction of gravitation* acts only upon large bodies, and is always in proportion to their masses; whereas *chemical attraction* affects only minute bodies, and has absolutely no influence upon such as are of any considerable bulk. *Gravitation* acts upon bodies placed at immense distances from each other; whereas *chemical attraction* never acts but with bodies in mutual contact.

We see then that these two attractive powers are different, and they are not natural to inert bodies, but a property implanted by the *Creator* no less confounding to the philosopher than that amazing property in animal bodies, which we denominate the life or soul.

This property of dead matter is of three kinds.

The first is where the integrant parts are united by a very considerable force, and forms the *hard or solid aggregate*. Thus two smooth plates

plates of any metal placed in contact, will so firmly adhere as to support many hundred pounds. Thus the particles of a diamond are so closely united, as to make one of the hardest substances in nature. This genus comprehends many species from the hardness of rock-crystal to the yielding texture of the softest wood.

The second is called the *pliant*, or *soft*, or *fluid aggregate*, where the parts may be easily moved backwards and forwards so as to change their relative situation : as wax, putty, and water.

And third, the *aeriform*, or *gaseous aggregate*, the tenuity of whose integrant particles renders them imperceptible, and in which the attraction of cohesion is the least possible.

These *three states* are however, properly speaking, but *one* and the *same power*, and most probably owe their distinctive difference to *caloric* or *matter of heat*, which pervades all bodies. The better to determine our ideas relating to this subject, which has not hitherto been sufficiently considered, let us, for a moment, conceive what would take place in the various substances which compose our earth, if its *temperature* were suddenly altered. If, for instance, we were transported

ported into the region of the planet *Mercury*, where probably the common temperature is much superior to that of boiling water. The rivers of the earth, and all the other fluids which are susceptible of the gaseous state, at the temperature near to that of boiling water, would become rarefied; and all these substances would be changed into permanent aeriform fluids or gases, which would become part of the new atmosphere.

By a contrary supposition to the one we have been forming, if the earth was suddenly transported to where the *Georgium Sidus* is, or some planet equally cold, the water which composes our seas, rivers, and springs, and probably the greater number of the fluids we are acquainted with, would be converted into solid mountains and hard rocks, at first transparent and homogeneous, like rock crystal, but which, in time, being mixed with different coloured earths, would form opaque stones of various colours. In this case the air would lose its elasticity for want of a sufficient temperature to retain it in that state: it would return to the liquid state of existence, and new liquids would be formed, of whose properties at this moment we have not the most distant idea.

Although these two hypotheses may give a tolerable distinct idea of our position, that *solid*, *liquid*, and *aeriform aggregates* are only three different states of existence of the same matter, or three particular modifications, which almost all sub-

stances are susceptible of assuming successively, and which solely depend upon the degree of *temperature* to which they are exposed; or upon the degree of *caloric* with which they are penetrated; yet as this opinion is the basis of all chemical science, I shall enter a little further into the consideration of this very important subject in the next section.

GENERAL LAWS RESPECTING HEAT.

SECT. V.

L A W.

ALL BODIES ARE EXPANDED BY HEAT.

1st. State of Expansion.

As comparisons with sensible objects are of great use in assisting us to form distinct notions of abstract ideas, we shall endeavour to illustrate this position, by instancing the phænomena which takes place between water and bodies which are penetrated by it. If we put a loaf of bread into water, this fluid will gradually insinuate itself into its pores, and the bread is soon considerably augmented both in weight and magnitude.—Or if we put a piece of wood into water, it will swell by admitting the water into its substance.—Or if a dry sponge be dipped in water, the sponge swells, its particles are separated from each other, and all its intervals are filled up by the water. The same circumstance undoubtedly takes place with regard to bodies which are immersed in free *Caloric* *. Thus if you take an iron tube, which is

* Distinguished thus from latent or combined heat.

filled up exactly by a rod, and heat this rod, it will be found too large for the tube, and will not enter it: and if you put it by the side of the tube, you will find it also longer than the tube, which when cold it appeared so exactly to fit. Its dimensions are therefore *increased* both in diameter and length. It is so with the rings on the finger. The ring which in health appeared exactly to fit, will drop off in the cold fit of an ague, and will be found on the contrary immoveable during the hot fit. It is upon this principle, that vessels and the wheels of carriages are bound with hoops heated red hot, and applied in this their *expanded* state, after which they pour cold water upon them, when the iron contracts with such force as to make a deep impression on the wood, and in this way the vessels are bound much faster than they would be by any other means. It is also upon this principle that our *thermometers* are constructed.

The first invention of this curious and useful instrument is somewhat obscure: but previous to the time of *Sanctorius* it does not appear that the expansive power of heat was much observed. *Sanctorius's* thermometer was a hollow glass ball, with a long cylindrical tube attached to it, with a small opening at the top, and therefore containing a quantity of air, and in order to observe the variation of the bulk, or elasticity which the air in the ball and tube underwent from the application

plication of heat, he first expelled a small quantity of air out of the vessel by applying heat to it. In consequence of which the air expands, and a small quantity of it comes out. He then puts the extremity of the tube immediately into a coloured liquor, and allows the vessel to become cool again; the consequence is, that the air loses the increase of its elasticity, and the internal air presses up a quantity of the fluid into the tube to fill up the room of the air that had been expelled by the heat, and having thus set up his thermometer, he then applied to the tube a scale of equal parts or degrees, which divides the cavity of the tube into a number of small and equal parts; and as the tube is cylindrical, we can see by these divisions, how the bulk of the air is increased at one time, and diminished at another. This kind of thermometer was used for a considerable time, when at last it was objected to by the honourable Mr. Boyle, that it could not be employed to ascertain the temperature of fluids, and owing to the changes which are known to take place in the weight of the atmosphere, it was fallacious even in those cases in which it could be employed; he therefore attempted to construct a thermometer on some other substance than air, and *spirit of wine* was first thought on, upon account of its being easily tinged, and the considerable change of bulk that it undergoes; and it was very easy to contrive the manner of confining the spirit

spirit of wine, or any other fluid, so as to observe distinctly the smallest variation of its bulk by putting it into a ball and tube, whereby a quantity rises in a small and slender thread, which can be easily measured, and divided into a number of small parts, the extremity of the tube being sealed hermetically, so that the pressure of the atmosphere could not affect it, nor could it suffer any loss from exhalation; thus the first useful thermometer was contrived by the Honourable Mr. Boyle. These thermometers were used for twenty or thirty years, till Dr. Halley and Sir Isaac Newton preferred *mercury*.

The *pulse glass*, as it is improperly called, depends also upon this principle. It is a bulb with a long neck to it. As the heat of the hand, following its natural tendency, immediately passes into the colder spirit of wine, in proportion as it enters it increases its bulk, and makes it gradually rise higher into the neck of the vessel, till it has acquired its utmost limit, when it appears to bubble; and to shew that it depends upon heat merely, it will do the same if immersed in hot water; and then if it be removed it will again diminish in bulk, and return to its former place.

Before I quit the subject of *expansion*, it may not be improper to notice, that a knowledge of this law enables us to understand the effect produced upon bodies that are remarkably brittle. Chemists know this but too well, and in private

families glasses are repeatedly broken by pouring into them warm water, and even the backs of grates are soon cracked if cold water be thrown upon them after they are quickly heated. In these cases the particles are torn from the colder parts by the expansive power of heat.

2d. State of Expansion, or that of Fluidity.

The first expansion carried a little further produces the state of *fluidity*. That this depends upon *absorbed heat* merely, is proved by the following experiment. If you take a quantity of ice, and put it into a basin, and carry it to a room in which the thermometer is at 50 degrees, from the increased temperature, owing to a fire in the chamber, and leave this ice for some time in the room, part of it will be melted. Apply then a thermometer, and it will point to 32 degrees. The same in five minutes, though evidently more heat has entered the mixture, and so continually until every particle of ice, or snow, has been melted. This can only be accounted for by supposing that the free caloric, or heat, has entered into combination with the water, and remains, as chemists are wont to call it, in a *latent* state. That is, the capacity of water for heat is greater than that of ice.

We may readily form an idea of the word *capacity*, by supposing a vessel filled with marbles, into

into which a quantity of fine sand is poured, which, insinuating into the intervals between the balls, will fill up every void. The marbles in this comparison are to the sand which surrounds them exactly in the same situation as the particles of bodies are with respect to the caloric, with this difference only, that the marbles are supposed to touch each other, whereas the particles of bodies are not in contact, being retained at a small distance from each other by the intervention of the caloric. If, instead of spherical balls, we substitute solid bodies of a hexahedral, octohedral, or any other regular figure, the capacity of the intervals between them will be lessened, and consequently will no longer contain the same quantity of sand. The same thing takes place with regard to natural bodies, the intervals left between their particles are not of equal capacity, but vary in consequence of the different figures and magnitude of their particles, and the different figures and magnitude of their particles are maintained, according to the existing proportion between their inherent attraction, and the repulsive force exerted upon them by the caloric. In this manner we must understand the following expression, introduced by the English philosophers, who have given the first precise ideas upon this subject, namely, the capacity of bodies for containing the matter of heat.

It is upon this principle also that *frigorific mixtures* are formed. The city of *Petersburgh*, which is contiguous to the sea, is exposed to a very in-

tense degree of cold, and that of the year 1760 being very excessive, the mercury stood even at 40 degrees below that of Fahrenheit's scale. This being the case, Professor Brown, of the academy there, had the curiosity to try whether by mixing together ice and strong nitrous acid he could congeal even mercury itself, and the artificial cold this produced was so great, that he actually accomplished his experiment, and the mercury in the bulb was converted into a tough metal, which bore a stroke or two of the hammer; and what was in the bore turned out a very fine and flexible thread. Thus if a mixture of sal ammoniac and snow be put over a fire, and we place in the middle of this a bowl with some water in it, whilst the snow and sal ammoniac is melting into a liquid, the water in the bowl will be congealed into a mass of ice. We can have no doubt here, but that heat enters into bodies as they become *fluid*, seeing it torn in so surprising a manner from water during the melting of the snow. We see then, that in the change of the ice from the *solid* to the *fluid form*, it *absorbed* a quantity of *heat*, even so much as to render mercury similar in its properties to all the other metallic bodies.

3d. *State of Expansion, or the Aeriform State.*

If you put a cup of æther in a basin of water, and place them in the exhausted receiver of an
air-

air-pump, the æther will assume an aeriform state, and the water in the basin will be frozen. In this experiment we see, that in the ordinary temperature of the earth, æther would always exist in an aeriform state, but for the pressure of the atmosphere, and that the passing of the æther from the liquid to the aeriform state is accompanied with a considerable diminution of heat; because during the evaporation a part of the caloric, which was before either free or latent in the surrounding bodies, combines with the æther, causing it to assume the aeriform state.

The effect of the pressure of the atmosphere in the conversion of bodies into these different states was first noticed by the honourable Mr. Boyle. He found, when making experiments with the air-pump, that water boiled at 90 degrees when the pressure of the atmosphere was taken off, and that therefore both the freezing and boiling points upon thermometers were in some measure defective, being dependant upon the height of the barometer; for when the pressure was greatest the water bore more heat, and vice versa.

In consequence of this discovery Papin formed his *digestor*. In this instrument bones may be dissolved, and the water may be made to acquire so great a degree of heat, that an iron wire will melt in it. For a description of this instrument see Vol. II. page 98.

Before we quit this subject, let us for a mo-

ment consider the cause of the *elasticity of air*. It is by no means difficult to perceive that this elasticity depends upon that of *caloric*, which seems to be the most eminently elastic body in nature. Nothing is more readily conceived, than that one body should become elastic by entering into combination with another body possessed of that quality. Elasticity is nothing more than that quality of the particles of bodies by which they recede from each other when forced together. We shall be satisfied of this, when we consider that air is susceptible of undergoing great compression, which supposes that its particles were previously very distant from each other, for the power of approaching together certainly supposes a previous distance, at least equal to the degree of approach.

The acquisition of this property exhibits some of the most curious phenomena we are acquainted with. As children we have been often delighted with *candle crackers*, but we should now contemplate them as men. They are hollow pieces of glass formed upon the extremity of a tube. This tube is made to contain a drop or two of water, and it is then hermetically sealed. When this is put near the flame of a candle, the water soon acquires the form of steam, the elasticity of which is gradually increased, until it bursts the glass with an exceeding loud crack, and with such violence, that usually the wick of the candle

is

is beat down upon the tallow as if it had received the blow of a hammer.

The distillation of substances depends wholly upon this principle. Steam or vapour is produced by the elastic power of heat. This we have before shewn to vary with the pressure of the atmosphere. Accordingly it is found, that when the air is light (indicated by the barometer being low) the fluid will boil sooner. When the barometer stands at 30 inches, water boils at the temperature of 212 degrees. If it stand so low as 28 inches, water will boil at 208. Hence in distillation we should diminish the pressure of the atmosphere. It is undoubtedly of great advantage to be able by the seclusion of air to work with smaller fires, and this would secure us also in a great measure from those fatal accidents which are often attended with the most terrible effects. Mons. Lavoisier was employed with his chemical friends on this important subject, when the Goth* of the eighteenth century, and his colleagues in iniquity, deprived the world of this great philosopher. The flimsy pretext was that he occupied the place of farmer-general, a receiver of taxes under the former government, but the real motive which produced this execrable action was the justly acquired riches which he was known to possess. Thus was cut off the Newton of the present age in the midst of his

* ROBESPIERRE.

useful labours; his house, filled with the most expensive chemical apparatuses, free for his numerous visitants, was despoiled; and the honourable rendezvous of men of letters was converted into a den of political thieves. When shall we find again combined equal spirit, industry, and great abilities, which an ample fortune enabled him to employ in their fullest extent! A great northern genius, when he had occasion to mention an circumstance, overcome by generous feeling, was unable to proceed, and was obliged to decline continuing the lecture. A century may not be able to repair the loss. It is however hoped, for the advancement of science, that the subject will not be entirely dropt. The laws which regulate the formation of elastic vapour, and the phenomena they exhibit, give us that link which closely connects chemistry with mechanical philosophy. Here we see chemical agents and mechanical forces set in immediate opposition to each other, and the one made the indication and measure of the other.

The *steam engine*, is the name of a machine which derives its moving power from the elasticity of the steam of boiling water. It is the most valuable present which the arts of life have ever received from the philosopher. The mariner's compass, the telescope, and other most useful discoveries, were the result of chance, and we do not know to whom we are indebted for them;

but the steam-engine was, in the very beginning, the result of reflection, and the production of a very ingenious mind; and every improvement it has received, and every alteration in its construction and principles, were also the results of philosophical study. This invention was made in the reign of Charles II. by the Marquis of Worcester, which he published with ninety-nine other contrivances of his own, which he extols, as of the highest importance to the public. It does not, however, appear that the noble inventor could ever interest the public by these accounts. He was branded as a projector, and the many failures which persons of this turn of mind daily experience, probably prejudiced people against him, and prevented all attention to his projects. The scheme however was revived in the year 1696 by Captain Savary, but it owes its present improved state to the philanthropic Mr. Watt, a person of a truly philosophical mind, eminently conversant in all branches of natural knowledge, and the pupil and intimate friend of Dr. Black, whose illustrious name will be often mentioned in this work, having of late turned his attention much towards the improvement of medicine by the formation and introduction of new aerial remedies, as also to the ingenuity of the Rev. Mr. Cartwright.

Without entering more diffusely into examples of the consequences of the change of capacity in
bodies

bodies when they are altered in their form, it may be observed, and repeated once more, that as the powers of *gravity* and *projection*, in continual opposition to each other, produce all the beautiful effects in the great system of the universe; so, among the actions of the minute parts of bodies, the *cohesive attraction*, and the *repulsion of heat*, are in continual opposition to each other, and are concerned in almost every process by which changes are produced in the peculiar properties, or chemical combination, of bodies.

To conclude. Besides the extensive influence of *heat*, chemists, in order to destroy as much as possible THE ATTRACTION OF COHESION, employ the mechanical operations of *pounding, hammering, rasping, filing, or cutting*, and not unfrequently the operation of *solvents*. Hence that adage, “Corpora non agunt nisi sint soluta;” by which means they give free scope for THE ATTRACTION OF COMPOSITION, or AFFINITY, or that attraction which takes place between bodies of different natures.

S E C T. VI.

THE ANCIENT OPINION RESPECTING OUR
ATMOSPHERE.

FORTUNATELY for my readers, the chemical knowledge necessary first to be learnt in order *clearly* to understand the *influence* of *air* on the *blood*, and *thence* on the *animal economy*, comprises the *most beautiful discoveries* in that science ; *discoveries* that have done honour to the last century and this age, and have immortalized the names of Hook, Mayow, Priestley, Lavoisier, Fourcroy, and Cavendish.

The Honourable Mr. Boyle has considered *our atmosphere* as *one large chemical vessel*, in which an infinite number of various operations are constantly performing. In it all the bodies of the earth are continually sending up a part of their substance by evaporation, to mix in *this great alembic*, and to float a while in common. Here minerals from their lowest depths ascend in noxious vapours to make a part of the general mass; seas, rivers, and subterraneous springs, furnish their copious supplies ; plants receive and return their share ; and animals, that by living upon consume this general store, are found to give it back in vast quantities when they die.

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The *air*, therefore, which every where presses on us, and upon which we subsist, bears very little resemblance to that *pure, simple, elementary body* generally imagined; and which is rather a substance that can be conceived, than experienced to exist.

Chemistry, however, has made great advances in *this curious research*, and it will soon appear that the composition of atmospherical air has been more *rigorously* determined.

S E C T. VII.

THE MODERN ANALYSIS

OF

ATMOSPHERIC AIR ;

Or its Separation into { 1. VITAL AIR.
2 ELASTIC FLUIDS, { 2. AZOTIC AIR.

CHEMISTRY affords two general methods of ascertaining the constituent principles of bodies, the method of *analysis* *, and that of *synthesis* †.

When, for instance, by combining *water* with *alkohol*, we form the species of liquor called *brandy*, we certainly have a right to conclude (by this synthesis) that *brandy* is composed of *alkohol* and *water*. And when by distillation of *brandy*, we obtain separate, *water*, and *alkohol* (by this analysis), our evidence of the constituent principles of *brandy* is then rendered complete; and in general it ought to be considered as a *principle* in chemical science, never to rest satisfied without *both these species of proofs*.

* From the Greek word αναλυσις. The separation of any compound into its several parts.

† From the Greek work συνθεσις. The putting together the several parts of a compound body.

LAVOISIER'S

LAVOISIER'S FAMOUS EXPERIMENT.

This illustrious chemist having placed 83 *grains* of fluid *mercury* in a *retort*, adapted to a *bell glass*, which enclosed 100 *cubical inches* of *common air*, he kept up in his furnace a constant fire, of such force, as to keep the *quicksilver* almost always at its *boiling point*.

On the second day small *red particles* began to appear on the surface of the *mercury*, which gradually increased in size and number for 4 or 5 days.

Convinced that the *calcination* of the *mercury* after that time did not go on, he extinguished the fire; and when the vessel was cool, he found in his bell-glass, instead of 100 *cubical inches* of *air*, only 86, and therefore a *loss* of 14 *cubical inches* of *air*.

Now, 14 *cubical inches* of *air* weighs 7 *grains*, and the *red particles* or *calx* of *mercury*, being carefully collected, weighed 97 *grains*. The *mercury*, therefore, by being calcined, had acquired an *increase of weight* of 7 *grains*, the *exact weight* of *air* which seemed *lost* *.

The 86 *cubical inches* of *air* remaining in the

* The conclusion is obvious, and in the next experiment we shall find, that the 14 *cubical inches* of *air*, which was *absorbed* by the *mercury*, and converted it to a *calx*, was the *vital* or *respirable part* of our *air*.

glass after this calcination was ended being examined, it was found to possess *these distinguishing properties*.

An animal being put into it was *suffocated* in a few minutes,—and when *a taper* was plunged into it, it was *extinguished*, as if it had been immersed in water *.

This gas, or *air*, has been called *phlogisticated air*, *non-respirable air*, *noxious or mephitic air*, *impure air*; but the French chemists have preferred the term *azotic gas* (*lethal air*) from the Greek words α , *privative*; and $\zeta\omega\nu$, *life*, as *this air* so quickly destroys life.

LAVOISIER'S SECOND EXPERIMENT.

HAVING taken 90 grains of the *calx of mercury*, the product of the *last process*, Lavoisier put it into a glass retort fitted to a proper apparatus for receiving aerial products.

Having applied a *much stronger heat* than in the former experiment, he observed that at first, in proportion as the *calx of mercury* became heated, the intensity of its colour augmented; but soon

* Not from any peculiar property of its own, but because the *vital or respirable part* was abstracted from it, as will be seen from the next experiment.

after the *calx* began gradually to decrease in bulk, and in a few minutes *its red colour altogether disappeared*, and the 90 grains of *calx* of mercury was converted into the 83 grains of *running mercury*, and 14 *cubical inches* of an *aerial fluid* passed over into the recipient.

Now these 14 *cubical inches* of air weighed 7 grains, the *exact weight* of the air consumed by the calcination of the mercury in the first experiment *; and the 83 grains of the *calx* of mercury reduced † to a *metallic state* being examined, had *lost in weight* 7 grains, the *exact weight* of the air now obtained. This air possessed these peculiar properties.

An animal being placed in it, became remarkably lively; a taper burnt in it with a *dazzling splendour*; and charcoal, instead of consuming quietly away, as it does in common air, burnt *with a flame*, attended with a decrepitating noise, and threw out such a *brilliant light* that the eyes could hardly endure it.

* Had the 100 *cubical inches* of atmospheric air contained a larger share of oxygen or *vital air*, more mercury would have been calcined. For calcination, as this experiment shews, is nothing more than the combination of *vital air* with any *metallic body*.

† From the Latin word *reduco*, to bring back. Reduction is the bringing back a metal converted into a *calx* in its *pristine state*.

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This species of air was *discovered* * almost at the same time by Dr. Priestley, Mr. Scheele, and Lavoisier. Dr. Priestley gave it the name of *Dephlogisticated* or *Pure Air*; Mr. Sheele called

* I know that some of the most eminent philosophers of the present day give to MAYOW the priority of the discovery of *vital air*. Having at last procured the scarce work of this writer, I was not a little surprised to find, that he had been very much over-rated. I have before proved that HOOK had anticipated him in many of his opinions. They both thought that the air contained in solution certain heavy *particles*, as aqua-fortis (the nitro-*acid*) after dissolving copper contains *particles* of copper in suspension. That these *fire particles* were in calcination and combustion, precipitated, just as when you put a piece of iron in a solution of copper in aqua-fortis, and the surface of the iron is immediately covered with copper, and from the *motion* of these uniting particles, *heat* was produced. Mayow has even a full chapter to prove that nitre did not contain *air*, but only solid *fire-particles*, and another to prove that these gave to the air its *elasticity*! All which seems to me to prove that MAYOW had not the smallest knowledge of *vital air*, nor indeed a just conception of our atmosphere, which modern philosophers have proved to be composed of two *distinct airs*, viz. VITAL, and AZOTIC, AIRS, and that in combustion, and calcination, not only a true decomposition of the *air* takes place; but also of the *oxygen*, or *vital air*, by which *heat* and *light* are liberated. Dr. Priestley, in 1774, seems, therefore, without knowledge of these obsolete and antiquated, I might say, false, ideas of Mayow, to have *discovered* a permanently elastic fluid, purer than common air; but amidst the variety of objects in the pursuit of his experimental inquiries, he then overlooked,

called it *Empyreal Air*; and Lavoisier first named it *Highly respirable Air*, or *Vital Air*; and afterwards, as it forms acids, by combining with certain bodies, he adopted the term *Oxygen Gas* (*Acid-making Air*), from the Greek words $\alpha\gamma\alpha\theta\acute{o}\varsigma$, *sour*; and $\gamma\epsilon\gamma\omicron\mu\alpha\iota$, *to beget* *.

THE

or rather neglected to consider, the phenomena of this wonderful fluid, which, of modern philosophers, was first presented to his view. Nearly about the time that Dr Priestley discovered the *Dephlogisticated air* in England, Mr Scheele, of Sweden, was engaged in making experiments on air and fire, which he published in German; and in those experiments we find also the discovery of *vital air*, called by Mr. Scheele, *Empyreal air*, both of whom appear wholly unacquainted with each other's discovery, which is confirmed by each of these philosophers arriving at the same conclusion by different roads. but undoubtedly Lavoisier was the *first* who proved, by direct and exact experiments, that the weight which metals gain by calcination corresponds with that of the air which they absorb; he was the *first* who ascertained, by the most decisive experiments, that the atmosphere consists of *two distinct fluids*, the one fit for the purposes of respiration and combustion, which he therefore called *VITAL*, or *PURE AIR*; the other unfit for either purpose, and thence called *POUR*, or *MEPHITIC AIR*; he *first* proved that *vital air* contained more *fire*, or *caloric*, than any other species of air; and that during combustion, ~~as~~ this air, or rather its *base*, was uniting to the substance, and adding its weight to the burning body, it gave out this *fire* in the form of *heat* and *light*.

* If *sulphur* or *charcoal* be burnt in *oxygen* or *vital air*, in a close vessel, and the fumes be condensed in water, this water will acquire an *acid taste*, and be increased in weight

THE SYNTHESIS,

Or Reunion of $\left\{ \begin{array}{l} 1. \text{ VITAL AIR,} \\ \text{AND} \\ 2. \text{ AZOTIC AIR.} \end{array} \right.$

LAVOISIER then repeated the same experiments as before^{ly} related, and *re-combined* the 2 *elastic fluids*, which he had separately obtained in the two experiments of *calcination* and *reduction*, viz. the 84 *cubical inches* of the AZOTIC AIR, and the 14 *cubical inches* of the OXYGEN AIR, and he produced from *this combination* an *elastic fluid* *precisely, similar in all its properties to atmospheric air*, contributing in the same way to a repetition of the same experiments, and possessing the same power of supporting animal life, and combustion.

weights exactly corresponding to the weights of sulphur or charcoal consumed, and that of the oxygen air destroyed. Sulphur united thus with oxygen, the fumes being collected in water, will form vitriolic acid; and charcoal combined with oxygen, and diffused in water, will form the carbonic, or aerial acid water.

The ~~names~~ of metals the French chemists call *oxides*, which signifies a body impregnated with a certain quantity of oxygen, but not *sufficient* to render it perceptibly acid

CONCLUSION.

The philosopher can have no remaining doubt as to the *composition* of *atmospheric air*: but the circumstances of these experiments might appear to him *more correct*, though probably at the time *less clear* to others, were it said, that *mercury*, at a certain temperature, overcoming the affinities * of *caloric* † and *azotic air* for

* If you take a bullet and divide it with a knife into two parts, provided these be smooth and rubbed together, they will strongly unite and form *one whole*. This is from a law impressed on matter called the *attraction of cohesion*. But should a particle of sand, or any roughness exist, the particles being divorced from each other, beyond the *sphere of mutual attraction*, they are no longer actuated by this law — The *attraction of cohesion* in *mercury*, at the common temperature, hinders the admission of *oxygen*, for which it has an *electric attraction* or *affinity*. But when exposed to a strong heat, the *caloric* expands this fluid; that is, insinuates itself through the body, and separates its particles (thermometers depend on this expansive power of fire), and, like the pieces of the bullet where sand interposed, the divided particles are no longer subject to the *law of cohesion*; then it is they obey the *law of attraction*, and each atom of *mercury* attracts to itself a particle of *oxygen*, just as a loadstone would draw to itself a particle of iron. — The loadstone *only attracts* iron. This represents the term *affinity* in chemistry. The mercury did not attract the *azot*, because chemists would say it had no *affinity* for it.

† Fire, or the matter of heat.

oxygen,

oxygen, attracts and fixes within itself oxygen *, (the base of oxygen air, for oxygen air is oxygen combined with a certain quantity of caloric :)—hence its increase of weight, and its conversion into an oxyd or calx, and hence the azotic, or lethal, air left us in the bell-glass.—That the temperature being increased †, the affinity of the caloric for oxygen becoming now superior to the attraction of the mercury, the oxygen is withdrawn from the oxyd of mercury by the superior attraction of the caloric ;—hence its decrease in weight, and its restoration to fluidity and splendour,

* An experimentalist would illustrate this by placing a needle between two magnets of different powers. This would represent oxygen between the two attractions of the caloric and azotic air. As we may suppose a loadstone to have an attraction for the needle superior to the two magnets, so would it draw the needle to itself from these, just as the mercury draws away from the azotic air and caloric, the oxygen.

† This is a curious fact, the temperature being increased, the caloric alone overcomes the elective attraction of mercury for oxygen, and depriving it of that principle, the attraction of cohesion takes place with the particles of mercury, and we obtain then running mercury and oxygen gas. To have recourse to the note on page 292, the oxygen and mercury being separated beyond their sphere of attraction, the caloric attracts to itself oxygen, just as either of the magnets (in the preceding note) would again attract to itself the needle, were it placed within its sphere of attraction, but beyond that of the loadstone.

and hence the produce of *oxygen*, or *vital*, *air*, clearly displaying to us this important truth.

“ *That atmospheric air is actually a compound of two heavy substances, azot* and oxygen†; which bodies, when combined with caloric, or the matter of heat, are aeriform, and may be procured in separate states, viz. in the condition of vital and azotic, air, which being mixed in a certain proportion constitutes our atmosphere ‡.*”

* That azot is a *solid substance* as well as *oxygen*, can be easily proved by experiment, consult page 39. That the application of heat should render *oxygen* and *azot* *gaseous*, is not wonderful, since we often observe *ice* by the admixture of *caloric* rendered a *fluid*, and heated to 212, converted into an aeriform and transparent gas. The hardest substance in the world, the *diamond*, may be volatilized in the same way. Mon. D’Arcet took a sphere of porcelain china, and after cutting it into halves, confined a *diamond* in the middle; he then joined the two sections strongly together. Putting these balls into a furnace, he afterwards unscrewed them, and found the diamonds evaporated, and the place which they occupied empty, though he could perceive no chink or fracture any where over the surface of the ball!

† The distinction betwixt air and vapour is this, both are formed of *particles* held in suspension by caloric, or heat, but by cold, or condensation, vapours return to their original form, whereas *airs* continue *permanently elastic*.

‡ In our climate the proportion generally is 3 of *azotic air* to 1 of *oxygen air*, as will be hereafter proved.

S E C T. VIII.

THE ANALYSIS

OF

OXYGEN AIR.

THAT *oxygen gas* is composed of $\left\{ \begin{array}{l} 1. \text{OXYGEN,} \\ 2. \text{CALORIC,} \\ 3. \text{\& LIGHT,} \end{array} \right.$

will be *evident* from the following very elegant experiment made by the celebrated Dr. Ingenhoufz.

A fine *iron wire*, twitted into a spiral *, being heated at its extremity red hot, and thrust into a jar containing only *oxygen air*, it instantly took fire, and burnt away rapidly †, exhibiting a bright light similar to that of Chinese fire-works, throwing out brilliant sparks, which fell to the bottom in the form of round globules ‡.

* This was done to render the experiment more striking.

† This experiment shews that *azotic air* retards the union of *oxygen* with bodies attracting it, which in some cases altogether prevents it.

‡ These were found floating on the mercury, and are natural *Martial Ethiops*. How much slower is the *calcination* or *rusting* of *iron* in other circumstances!

At the beginning of the combustion there is a slight augmentation in the volume of the air in the bell-glass, from the dilatation caused by the caloric or heat; but presently after a *rapid diminution* takes place, and *the mercury rises in the glass*, inasmuch that when the *quantity of iron is sufficient*, and the *oxygen air operated on is very pure*, almost the *whole air employed is absorbed**, —or should the *quantity of iron be insufficient*, the *remaining air unabsorbed* will be found *perfectly pure vital air †*.

The *theory* of this experiment is the same as the last. At a certain temperature *iron* has a *stronger affinity* for the *oxygen*, than *caloric* and *light* have. It *therefore* attracts to itself the *oxygen*, and *caloric* and *light* becoming disengaged ‡, are rendered *active* and *evident* to the senses.

The

* That is, if 100 grains of iron be consumed in 70 cubic inches of oxygen air, the whole volume of air will disappear; and as 70 cubic inches of oxygen air weigh 35 grains, the 100 grains of iron will weigh, in its state of oxyd or calx, 135 grains.

† As pure or oxygen air is found unaltered, the *metaphisic air* left us in the calcination of the mercury could arise only from the abstraction of the oxygen air.

‡ As the calcination of the mercury, in the first experiment, lasted several days, the disengagement of caloric and light was extremely small for each particular moment of time, and therefore not perceptible to the sight. The heat,

The burning of all bodies is then nothing more than the *decomposition* of oxygen air. It is the *air*, therefore, and not the combustible body, that gives out *light* and *heat*.

When we are sailing on the water in a still day, *distinct objects appear to meet us*, but our reason corrects the delusion. When we behold the sun, moving from east to west, philosophy again assumes its empire, and we are convinced it is *stationary*. If we take a *prism*, it displays to us a variety of colours; our reason tells us here also, that *these colours* arise from the *rays of light*, and are not *in the prism*,—so of the combustion of bodies, the *caloric* and *light* are not from *the wax* of our candles, but from the *oxygen air*, which, as we have seen in the above experiment, becomes, under certain circumstances, *decomposed*.

heat, also, of the furnace was confounded with it, which made it necessary to relate Dr. Ingenhousz's experiment, where *the combustion* of the metal was more rapid, and unconnected with any furnace.

S E C T. IX.

T H E S Y N T H E S I S

O F

W A T E R ,

Or its formation from its { 1. HYDROGEN.
2 CONSTITUENT PARTS, { 2. OXYGEN.

Water and air, says Sir Isaac Newton, composed of old worn particles and fragments of particles, would not be of the same texture and nature now as at the beginning, did not the primitive particles of matter continue entire, and compose bodies of the same nature and texture in all ages. The changes of corporal things are to be perceived only in the new configurations and new associations of the permanent particles. OPTICS, page 376.

PRIOR to our entering upon the subject of the effects of air on the animal economy, it will be necessary to shew, also, that *water*, though it be the solvent of a vast variety of bodies, is neither that *compound* or *simple element* formerly supposed, but made up of two *very distinct* and *different principles*.

The new and beautiful doctrine of the French chemists, respecting the composition of *air*, the
nature

nature of *combustion*, *calcination*, &c. was daily gaining ground, and obtaining the applause of every one, when an experiment performed by Dr. Priestley made it for a while totter on its basis.

In the middle of a long glass tube this great experimentalist put some *calcined lead*, and affixed to the extremities *bladders* which were filled with *inflammable air* *. Having applied a strong heat to the middle of this tube, he next squeezed the bladders, and forced the *inflammable air* along the tube.

The *inflammable air* soon disappeared; no *oxygen gas* was evolved: but the *red lead* quickly *re-assumed* its original metallic splendour.

A question then arose, whence *this property* in *inflammable air* which the *antiphlogistians* would ascribe to the evolution of *oxygen gas* †.

The

* *This air* Dr. Priestley obtained from *diluted vitriolic acid* poured on iron. Iron was therefore said to contain a great quantity of *this air*. But the fact will soon appear that the air arose from the *decomposition of the water* mixed with the vitriolic acid. *Inflammable, or hydrogen, air*, being 15 times lighter than common air, it is employed for balloons.

† *Inflammable air* quickly destroys life, whereas *oxygen gas* appears to be the very principle of life. It is considerably lighter than either *oxygen* or *common air*. It explodes when it comes into contact with *common air*, but
more

The favourers of the new system were not able to deny the fact; and as the *inflammable air*, which was now called *phlogiston*, had in this experiment *disappeared*, they found some difficulty to persuade *the supporters of the old doctrine* that the *revival of the metal* could not be from the *absorption* of the *inflammable air*, as the *red lead* had *lost* a good deal of its *weight*, and the *effect* of an *addition of matter* (if *inflammable air* be *matter*) could be no other than to give it an *increase of weight*.

Fortunately for chemistry the Honourable Mr. Cavendish, by passing an electric shock through *oxygen air* blended with *inflammable air*, produced *water**. *The reduction* of the *red lead* in Dr. Priestley's experiment was then no longer a matter of surprise. At a *certain temperature* the *inflammable air* overcoming the attraction of the *lead for oxygen* divorced it of *that principle*, and uniting with it formed *water*.

more especially with *oxygen air*, provided any body in actual inflammation be present. The difference therefore between these two airs is great.

* 85 grains, by weight, of *oxygen air*, and 15 grains of *inflammable* or *hydrogen air*, produced here precisely 100 grains of *water*. In this experiment *caloric* is disengaged, and the 85 parts of *oxygen* and 15 of *hydrogen* unite, which, being naturally *solid substances of themselves*, become, if nearly all the *caloric* be extracted from them, *ice*; it less, *water*.

THE ANALYSIS,

OR

Its separation into { 1. HYDROGEN AIR,
2. & OXYGEN AIR.

But that no doubt may be entertained on this head, I must beg leave to relate an experiment which was performed by Meusnier before a large assembly of the Academy of Sciences at Paris.

He took a *gun-barrel*, into which he put some thick pieces of *iron-wire* flattened by the hammer. He *weighed* the whole with a scrupulous exactness. He then *luted* the *gun-barrel* to secure it from the immediate contact of the fire. It was then placed in a *furnace*, but so *inclined* that water would readily glide down it. He adapted to the upper extremity a *funnel* containing water, from which it could not escape into the *gun-barrel* but drop by drop. This *funnel* was *closed at the top* to avoid any the least evaporation of the water. At the lower extremity *vessels* were adapted to receive any aerial product. To use every precaution *these* were exhausted of their air.

The *gun-barrel* was now made red hot, and

the *water* from the funnel passed into it drop by drop.

An astonishing quantity of *inflammable air* * was quickly obtained.

Having removed the luting, the *gun-barrel* with its *contents* weighed considerably *heavier* than *before*; and the *acquired weight* of the *gun-barrel* being *added* to the *weight* of the *inflammable air* thus produced, was *precisely* the *weight* of the *water expended* in the process: and the *iron-wire* found in the barrel (the process being over) resembled in every respect *iron* that has been consumed in *oxygen air*, that is, it was become an *oxyd of iron*, which accounts for the *oxygen*, the other constituent principle of *water*.

Another proof that *water* is composed of *hydrogen* and *oxygen* may be drawn from the celebrated experiment of Mr. Watt. This illustrious chemist wet powdered charcoal, and put it so moistened into a retort. Fire being applied, *hydrocarbonate air* † is soon formed; that is, *hydrogen*

* This *inflammable air* was generated from the *hydrogen* of the *water*, which united with the *caloric* of the furnace in its passage through the barrel. *Inflammable air* the French chemists call *hydrogen gas*, from the Greek words *υδωρ* *water*, and *γενωμαι* *to beget*.

† This air, which is applied medicinally, was the happy discovery of Mr. Watt. This benevolent philosopher also

drogen air, or *inflammable air*, mixed with fixed air, which, in the next section, we shall find is composed of charcoal and *oxygen*.

also taught physicians an easy process for obtaining *vital air*. His simple apparatus is a furnace, in which is placed an iron retort filled with finely powdered *manganese*. An iron gun-barrel enters the mouth of the retort, and at its other extremity is connected with his *pneumatic receiver*, or with any vessel filled with, and immersed over, water. The furnace is then filled with charcoal and lighted, and *vital air* is obtained very rapidly, and in considerable quantity. The luting that Dr. Thornton discovered to be the best is glazier's putty mixed with sand.

S E C T. X.

THE ANALYSIS

OF

CARBONIC ACID AIR, OR FIXED AIR;

Or its separation into its { 1. CHARCOAL,
2 CONSTITUENT PARTS, { 2. OXYGEN AIR.

MR. TENANT, a famous chemist of Emanuel College, Cambridge, having procured a glass tube hermetically sealed at one end, luted it over with clay and sand to prevent the sudden action of the fire. He then introduced into it some *phosphorus* and powdered *marble**, and having closed the open extremity, he applied to the tube a quick heat, and the result was, when cold,

1. *Phosphoric acid* † combined with *calcareous earth*.

2. *Phos-*

* If *vitriolic acid* be poured on *marble*, *fixed air* is given out in great abundance. Mr. Tenant therefore assumes this data, *that marble contains fixed air*. As the residue is *vitriolic acid* and *calcareous earth*, *marble* is known also to contain *calcareous earth*.

† *Phosphorus* and *oxygen*. The answer to this natural question

2. *Phosphorus* combined with the *same earth*.
And

3. A *black substance*, which differed in nothing from *charcoal* made from vegetables.

If *vitriolic acid* * be poured on *marble*, this acid possessing a superior power of combination or attraction for the *calcareous earth* of the marble, than the *carbonic acid* † has, it unites with the *calcareous earth*, and the *carbonic acid*, becoming disengaged, attracts to itself *caloric* ‡, and escapes in the form of *gas* §.

Marble is therefore a } 1. Oxygen, combined with
compound of 3 bodies, } 2. Charcoal, or the carbonic acid; and
 } 3. Calcareous earth.

The theory of Mr. Tenant's experiment will be now easily understood.

question, *Hence this oxygen?* is clearly demonstrated overleaf.

* Sulphur and oxygen

† Charcoal and oxygen. Fixed air is charcoal, oxygen, and caloric.

‡ The caloric proceeds in part from the *vitriolic acid*, which acid, if poured on *water*, will almost make it *boiling hot*, to the no small astonishment of persons unacquainted with chemical operations. Since *two cold bodies*, coming into contact with each other, give out *heat*, *caloric* we see may be in a *dormant* or *latent* state, and that in condensation of oxygen into bodies, only a part of the caloric is disengaged from the vital air.

§ Viz. Carbonic acid gas, or fixed air; which is charcoal (carbon), oxygen, and a certain quantity of caloric.

At a certain temperature *phosphorus* (which is a simple body) overcoming the attraction of the *charcoal* for *oxygen*, deprives the *carbonic acid* of its *oxygen*, and becomes, in consequence,

1. *Phosphoric acid* *, which unites with the *calcareous earth*.

The *phosphoric acid* being *saturated* † with the *calcareous earth*, we have also,

2. *Phosphorus* united with *calcareous earth*.
And,

3. The *charcoal* of the marble is left us in its *simple state* ‡.

The proof, however, by synthesis, that the constituent principles of *fixed air*, are *charcoal*, and *oxygen air*, is more beautiful, as being easier understood.

* *Phosphorus* and *oxygen*.

† If *diluted vitriolic acid* be poured on marble, an effervescence denoting the extrication of *fixed air* is seen, when the union of the *vitriolic acid* and *calcareous earth* is *complete*, it is said to be *saturated*, the effervescence now ceasing.

‡ The *oxygen*, with which it was before combined, being separated from it, by the *superior attraction* of the *phosphorus*.

THE SYNTHESIS,

Or Union of the { 1. CARBON,
 2. & OXYGEN AIR.

This *charcoal* * Mr. Tenant then burnt in *oxygen air*, which was converted into an *acid gas*, whose *weight* equalled the sum of the *weights* of the *charcoal* which had been burnt, and the *oxygen air* employed.

Fixed air, or the *carbonic acid air*, is composed of 28 parts of CHARCOAL to 72 of OXYGEN AIR; or, in other words, 144 cubic inches of *oxygen air* will saturate or take up 28 grains of *charcoal*.

This acid gas had all the *properties* of *fixed air*. It was readily upon agitation *imbibed by water* †, which acquired the sparkling appearance and taste of Pyrmont and Seltzer water. *This acidulated water* dissolved iron filings, and became a perfect

* *Any charcoal* would have given the same product.

† We owe our first knowledge of *fixed air* to Dr. Black, but that *water* absorbed *this air* upon agitation, and was made Seltzer or Pyrmont water, and that if *iron filings* be put into *this acidulated water*, it becomes a *chalybeate*, we are indebted to the happy industry of Dr. Priestley.

chalybeate water. *This air, like fixed air, weighed heavier than common air. A candle being put in it, was quickly extinguished, and an animal died convulsed in it.*

Having sufficiently explained the chemical composition of substances that have a most important part to perform in the animal economy, (as will be presently seen) we will now proceed to the consideration of the other properties of atmospheric air.

SECT. XI.

OF THE WEIGHT OF THE AIR.

As light as air, is an expreffion made ufe of in common converfation, yet it is much heavier than is commonly imagined. We have numberlefs proofs of its weight, many of which though the ancients could eftimate as well we, yet they confidered it as a fubftance totally void of gravity, and called it an element. An element was different from earthly matter, and therefore they confidered it as wanting ponderofity. However all material fubftances, of which air is one, have weight; like other bodies it falls to the earth, and is more denfe as it approaches its centre. Every one knows that air on the tops of high mountains is much rarer and thinner than it is below in the valley; if any fhould doubt it, the difference they will find in drawing their breath in the different places will foon convince them. As they go up a very high mountain their breathing becomes quicker, the atmofphere becomes clearer, neither clouds nor vapours are able to rife to fuch heights, and therefore as he afcends the traveller leaves the tempeft and the ftorm midway below him. Ulloa, who went to

take the measure of a degree upon the Andes in Peru, which are the highest mountains in the world, tells us, that when clouds gathered below the mountain's brow while he stood on the top, they seemed like a tempestuous ocean all dashing and foaming beneath him, here and there lightnings breaking through the waves, and sometimes two or three suns reflected from its bosom. In the mean time he enjoyed a cloudless and serene sky, and left the war of the elements to the unphilosophical mortals on the plain below him.

Such appearances as these, with which the ancients might be as well acquainted as we, should have led them to consider the air as having weight; but they were not at this time acquainted with a machine which serves to discover its weight by proofs much better calculated for conviction than those brought from untried nature. The machine I mean by which we so plainly discover the weight of the air, is the air-pump. For the first invention of this, the world is indebted to Otho Gueric, a German: but it was our countryman Boyle who turned it to real use, it was he who improved it, and applied it to philosophical purposes. In the hands of Gueric it was a mechanical instrument; in those of Boyle it was a truly philosophical machine. By it we can with ease empty a glass vessel of its air, and put what bodies into it we think fit. Thus comparing the changes wrought upon bodies by be-
ing

ing kept from air, with the same bodies when exposed to air, we come to a precise knowledge of the effects of air upon bodies in general.

By means of this instrument the first thing we learn is, that the air is actually heavy. If a vessel be by means of the air-pump exhausted of its air, if we clap the palm of our hand to its mouth we shall quickly perceive the weight of the air upon the back of the hand, pressing the hand in a manner into the vessel. If a part of the skin of a bladder should be placed there instead of the hand, the external air would break the skin with great force, and rush into the vessel with a noise. If the air be pumped out of a square glass vessel, the weight of the external air will break the glass into shivers. But to put the air's weight past all doubt, we can actually weigh it in a balance, and it is there found heavy.

Having exhausted the air out of a thin glass flask, and suspended it at one end of a balance, which being nicely counterpoized by weights in the other scale; this done, admit the air into the flask, into which it will rush with a noise, and though the flask was balanced before, it will now upon the admission of the air become heavier and preponderate. If the flask holds a quart, it will be found that the weight of the air it now contains is about seventeen grains above what it was when quite empty, so that a quart of air

weighed upon an average in the open air, is about seventeen grains.

Now, if a single quart of air weighs so much, what would not a pillar of air weigh, the base of which rests upon earth, and whose top reaches several miles above the clouds? The weight of such a pillar, how extraordinary soever it may seem, can be determined with the nicest precision. We mentioned just now with what extreme weight such a pillar rested upon the back of the hand which had no air under it to keep it up, or balance the weight above it, but we cannot precisely tell how great that force is as yet. Let us go a little farther then, and see with what weight this high pillar of air would press upon the surface of a tub of quicksilver. Let us suppose a long glass tube exhausted of all air, and stopped close at the top, to be plunged at the other end into it. It is evident that the air will press upon the surface of the quicksilver without; and if there were air in the tube, it would press upon the surface of the quicksilver within the tube also: but there is no air at all, as was said, within the tube, for that was exhausted before the experiment; so that in short all the air will press upon the quicksilver on the outside of the tube, and none upon that within. The air, therefore, as it has great weight, will press the external surface of the quicksilver all over, and drive it up into the hollow of the tube, where there is no pressure

from air at all. As if I pressed down the palm of my hand upon water, the water would rise up between the interstices of my fingers where the pressure was least: by means of this pressure of the heavy air upon the quicksilver, the quicksilver will be driven up into the tube, and rise in it, if the tube be long enough, about twenty-nine inches and an half high.

Thus then the air presses down with a weight capable of making quicksilver rise to twenty-nine inches and an half. A pillar of air therefore that reaches to the air's greatest height, is just as heavy as a pillar of quicksilver of the same diameter that measures exactly twenty-nine inches and an half. For the weight of the air pressing down must be just exactly equal to the weight of the quicksilver that is pressed up. When one body raises another to its highest pitch, and can raise it no more, the body raised then equals the body raising. We may therefore boldly conclude, that a pillar of air which reaches from the top of the atmosphere, weighs just as much as a pillar of quicksilver twenty-nine inches and an half high. The weight of such a pillar we can easily estimate, and consequently measure the weight of the atmosphere; but first let us mention another case similar to this of the quicksilver, which is water.

If by any means we exhaust all the air from a vessel more than thirty-two feet high, and stopping

ping one end, set the other in water, the water will rise thirty-two feet within the vessel and no higher, for the weight of the air will press upon the surface of the external water as it did before upon the surface of the quicksilver, and press up the one as well as the other with all its weight. A pillar of water of thirty-two feet high just weighs equally with a pillar of quicksilver twenty-nine inches; the air therefore presses up that thirty-two feet, as it pressed up this twenty-nine inches. The weight therefore of a pillar of the atmosphere is equal to either a pillar of quicksilver twenty-nine inches high, or to a pillar of water thirty-two feet high; it is equal to either, for they are equal to each other.

I shall mention an obvious experiment to this purpose, which the student can put into practice without any apparatus while at tea. Some water being poured into a saucer, let him burn a bit of paper in a tea-cup, which will rarefy and exhaust and make a vacuum in the cup. Then while the paper is yet burning, let him turn it down paper and all into the saucer, and the air without will press the water up from the saucer into the cup. The water will stand within the cup in a column, and if the cup were thirty-two feet high, and the air within it perfectly exhausted, the water would rise so high in it, as we have said before.

If what has been said is well understood, the
student

student will be at no loss to account for the rising of water in pumps, or the standing of the quicksilver in the barometer.

All these appearances in nature are performed, as was said, by the weight of the air pressing the fluids into places where there was no air, nor any other resistance. But though these truths are now as obvious as they are astonishing, yet for many ages the causes of the ascending of water in pumps was utterly unknown. Philosophers were content with thinking after Aristotle, and his opinion was, that nature hated a void or empty space, and therefore made all possible efforts to fill it when the art of man had made one. All this may be very true; but we want to know, why nature hates this void? And here their philosophy was puzzled. Torricelli was the first who undertook to explain, as we have seen, why nature made haste to fill up this void. An accidental experiment put him into the right road towards the discovery. Having filled a tube, which was stopt at one end, with quicksilver, and then fixed this tube with its open end in a tub filled with the same: the quicksilver in the tube did not all descend into the tub, but stood in the tube at the height of twenty-nine inches and an half. This experiment was soon communicated to the learned of Europe: the genius of the times all over Europe was then employed in quest of new discoveries; Boyle, Paschal, and Riccioli, set themselves to consider

consider this new phænomenon; and this led them to the following conclusions. Water rises in a void thirty-two feet high, as we have for ages seen in pumps; quicksilver stands twenty-nine inches high, as we see in this new experiment; a pillar of the one weighs exactly as much as a pillar of the other; the ascent of both therefore must be ascribed to one and the same cause. And why may not this cause be owing to the pressure of a pillar of air? And if the pressure of this pillar of air were taken away, would the quicksilver then stand in the tube? Let the Torricellian tube, vessel, quicksilver, and all, be placed under the glass of the air-pump, and let the weight of the air be taken away from the quicksilver; it will then be found to stand no longer suspended in the tube, but will sink down to the same level with the rest of the quicksilver in the vessel in which it is placed. This was enough, and indeed fully sufficient to convince them, they pursued the track of light where it led, and at length they deduced a theory of the air equally clear and convincing.

We mortals, who are upon the surface of the earth, said they, resemble fishes at the bottom of the ocean: like them we are enveloped in a fluid of air, which rises far above our heads, an ocean of atmosphere, which while on earth we cannot quit. This atmosphere surrounds our whole earth for some miles high, enveloping the earth
on

on every side. Let us suppose the tops of the highest mountains thrusting up their heads through this great fluid, like rocks in the ocean that almost rise to, but not quite so high as the surface. As the parts of this ambient atmosphere are all heavy, they press down one upon another, and those parts that are lowest will suffer the greatest pressure, as they have the greatest number of parts above pressing them down. The lower valleys, will, therefore, suffer greater pressure from the atmosphere than the higher mountains. Let then the Torricellian tube be brought into a low valley: here the pressure upon the quicksilver will be greatest, and it will rise above twenty-nine inches and an half. Let it be now brought up to the top of an high mountain: here the pressure will be least, and it will sink down proportionably. On the summit of Snowdon-hill, Dr. Halley found the barometer above three degrees lower than at the bottom. On the summit of an Alpine mountain, the Abbe Nollet found it a quarter less high than on the plains of Piedmont. Thus therefore the tube of Torricelli, by the quicksilver rising or falling, will serve very exactly to measure the weight of the air.

As the quicksilver in the tube sometimes in the same place stands an inch or two higher, and sometimes several inches lower, than twenty-nine inches and an half, it is very plain, that the air is sometimes heavier and sometimes lighter: that
when

when heavier, it presses up the quicksilver above twenty-nine inches; when lighter, the quicksilver suffering less pressure rises not so high.

The tube therefore will exactly determine these variations, and its heights will alter with every change. This instrument was first called the Torricellian Tube; but being now made use of for measuring the alterations and weight of the air, it is called the Barometer, or Weather-glass. The simplest, and perhaps best method of making the barometer is thus: a glass tube, of about thirty-five inches, hermetically sealed at one end, is to be filled with quicksilver. Hermetically sealing a glass is no more than holding the end in the flame of a candle, or fire, until the glass softens, and then twisting it round, so as quite to close up the orifice, it being first filled with quicksilver well purged of its air, which is done by boiling the quicksilver in water. The finger being then placed on the open end, this end is set into a basin of the same prepared mercury. Then upon removing the finger, the mercury in the basin will join with that in the tube, and that in the tube will sink down to about twenty-nine inches and an half, one time with another. Instead of a basin at the bottom, the lower end is usually turned up, and dilated into a sort of cup, containing a quantity of quicksilver; upon which the air presses, and so drives it up along the bend of the tube to the usual height. This tube thus

fitted and filled is then fastened to a board, which has the inches marked upon it; and towards the top those inches are divided into their parts, in order to measure the rising and falling of the quicksilver more precisely. (Vide Nollet, fig. 25, vol. II. plate 5.)

An instrument contrived in this manner will pretty nearly serve to measure the weight of the atmosphere; it will not precisely measure its weight, because it is affected also by another property of the air, namely, its elasticity or spring, as we shall see in its proper place. By this instrument we learn, that the air is changing its weight continually, being sometimes more heavy, sometimes more light; but upon an average, its weight (and spring together) are able to press up a pillar of quicksilver twenty-nine inches and an half high, or a pillar of water thirty-three feet high.

What we have now seen with regard to pumps, we may every day see practised in a smaller degree by the common syringe. If one of its ends be put into water, and the piston be drawn up, this will make a space void of air, and the water will be pressed up into the void, and thus fill the syringe.

When children suck at the breast, it is by natural mechanism somewhat resembling that of the syringe; for the child draws into its lungs the air in his mouth, then stops its entrance by the nostrils, and next squeezes the nipple between

tween its lips, so that no air can come that way. Thus there is a void in the mouth, and the external air pressing upon the mother's breast, squeezes the milk into the infant's mouth, and by this means it finds the nourishment proper for its support.

Cupping-glasses may be explained upon the same principle. That part of the body under the mouth of the glass has no pressure of air upon it; for the air was driven out of the glass by heat, before the glass was applied. The flesh of the body is raised to that place where it finds least resistance.

The atmosphere thus pressing down upon the surface of the earth envelopes all the bodies upon its surface, and presses them together. The whole earth may be considered to suffer as great a pressure from the atmosphere, as if it were pressed on every side by water thirty-three feet deep; and all that are upon the earth's surface are as much pressed on every side as we would be, if instead of an airy atmosphere we had an atmosphere of water, like fishes, thirty-three feet above our heads. The weight of such an atmosphere of water can be easily calculated. A cubic foot of water we will suppose to weigh 60 pounds, 33 feet will weigh 33 times 60, that is 1980 pounds. Suppose a middle-sized man has a surface of about 14 feet square, he will sustain 14 times 1980 pounds of water, that is 27,720 pounds.

pounds. If a man sustains so much, who is but 14 feet square, how much weight of atmosphere will not the whole earth sustain, which hath a surface of more than two millions of square miles? Thus, whether the earth sustains a weight of water thirty-three feet high, or an airy atmosphere equal in weight, the difference is nothing, it will be equally pressed by both. Thus, in the atmosphere in which we move with so much freedom, and which we traverse with so much rapidity, we are pressed on all sides with an almost incredible weight, and our bodies seldom support less than twelve ton of air at a time.

So great a pressure of air upon his body may well surprise the ignorant, and shake his belief; but he must consider, that this weight of air he has carried from his earliest infancy. Sensations to which we have been always accustomed, are scarce felt: we cannot perceive the difference of things, when we have no standard by which to measure their variations; we cannot perceive the weight of the air, because we have always felt its weight, and cannot remove from its pressure. No one part of the body can be disturbed by its pressure, for it lays the load equally upon all. Besides this, there is a resistance within the body, which serves to counterbalance that from without; and there is another consideration also, which naturalists have passed over unnoticed. The heat of our bodies rarifies the air on their surface; so

that in fact an animal doth not sustain so great a pressure from the air as cold inanimate substances are found to sustain. In short, to use the words of Borelli, since by the air's pressure none of the parts of our bodies can suffer either separation, or luxation, or contusion, nor any other change, it is impossible that this pressure can produce any pain.

This pressure then can do no injury to the animal frame, we find it by experience of infinite utility. By it the parts of our bodies are kept compactly together, by it the fluids in our vessels are prevented from bursting their canals. Travellers, in ascending high mountains, feel the want of this pressure, to which they were accustomed in the valley: as they ascend, they perceive a total lassitude upon them from the dilatation of their vessels, and at last the blood begins to burst through the fine coats of the lungs, and they spit blood. It is probable that similar effects are not unfrequently produced by this variation in the weight of the atmosphere. Mead relates that Dr. Pitcairn, in the year 1787, being at his country seat near Edinburgh, in February, on a fairer day than usual at that season, was seized with a sudden bleeding of the nose after an uncommon faintness, and on the next day, on his return to town, he found that the *barometer* was *lower* at that very hour than either he or his friend Dr. Gregory, who kept a journal

nal

nal of the weather, had ever observed it: and that another friend of his, Mr. Cockburn, professor of philosophy, had died suddenly at the same hour by an eruption of blood from the lungs; and also five or six others of his patients were seized with different hæmorrhages.

S E C T. XII.

AIR SUPPORTS LIFE.

To shew “*that air is absolutely necessary for the preservation of life,*” many have been the animals that idle curiosity has tortured in the prison of a receiver. We shall, from a thousand instances, produce that of the *viper*, as it is known to be a reptile exceedingly tenacious of life, and as we shall feel but little compassion for its sufferings.

Mr. Boyle took a new caught viper, and shutting it up in a small receiver of an air-pump, he exhausted the air. At first the reptile began to swell, it then moved up and down as if in quest of air, and after a while foamed, leaving the foam sticking to the sides of the glass. It continued in this state 23 hours, and appeared by its posture, even after the lapse of two hours, *lifeless*. But upon the air being admitted, the viper opened and closed its mouth, and continuing these alternate motions for a few seconds, it still argued some remains of life. Other creatures, in the exhausted receiver, much sooner grow convulsed and die.

S E C T. XIII.

THE AIR MUST BE RENEWED.

As *air* was shewn to be *absolutely necessary for the continuance of life*, “*so is a due supply of it indispensable.*”

The soubah, or viceroy of Bengal, dying in the month of April, in the year 1756, he was succeeded by his adopted son Sur Raja al Dowlah, a young man of the most violent passions, without faith, principle, or fortitude.

In the month of *May*, he caused the English factory at *Cassimbuzar* to be invested, and invited Mr. Watts, the chief of the factory, to a conference; he detained him as a prisoner, and made himself master of the factory.

He then marched to *Calcutta*, and invested this settlement, which was in no posture of defence. The *governor*, intimidated by the numbers and power of the enemy, abandoned the fort, and together with some of the principal persons residing in the place, took refuge on board a ship in the river, carrying with them their most valuable effects.

The defence of the place then devolved to Mr. Holwell, the second in command; who, with the assistance of a few gallant officers, and a very small

garrison, maintained the place with singular courage and resolution, till at length, the enemy having forced their way into the castle, he was obliged to surrender; the soubah having first promised him, on the honour of a soldier, "that no injury should be offered him or his garrison."

Having made them prisoners, he ordered them, to the number of 146 persons, to be put into a place called the *Black-hole* prison, a cube of about 18 feet, open only to the westward by *two windows* strongly barred with iron.

The humane reader will conceive, with horror, the miserable situation to which they must have been reduced, thus stewed up, in a *close sultry night*, under the climate of Bengal, especially when he reflects that many were *grievously wounded*, and all of them *greatly fatigued* by the exertions of the preceding day.

A *profuse sweat* quickly broke out on every individual, attended with an *insatiable thirst*, which became the more intolerable as the body was drained of its moisture. It was in vain that they stript off their clothes, or fanned themselves with their hats.

A *difficulty in breathing* was next observed, and every one *panted for breath*.

Mr. Holwell, who was placed at one of the windows, accosted the serjeant of the guard, and endeavouring to excite his compassion, he drew a pathetic picture of their sufferings, and promised to gratify him in the morning with a thousand rupees,

provided he could find means to remove some of his people into another place of confinement.

The Indian, allured by the promise of so mighty a reward, assured him he would use his utmost endeavour, and retired for that purpose.

What must have been the impatience at this time of these unhappy objects? — — — —

— — — — —
 — — — — —
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In a few minutes the jemmaudar returned, *but the tyrant*, by whose order alone such a step could be taken, *was asleep, and no one durst disturb his repose!*

The despair of the prisoners now became outrageous. They endeavoured to force open the door, that they might rush on the swords of the monsters, by whom they were surrounded, and who derided their sufferings; but all their efforts proved ineffectual. They then used execrations and abuse to provoke the guard to fire upon them.

The jemmaudar was at length moved to compassion. He ordered his soldiers to bring some skins containing *water*, which, by enraging the appetite, only served to increase the general agitation. There was no other way of conveying it through the two windows but by hats, and this mode of conveyance proved ineffectual, from the eagerness and transports of the wretched prisoners who struggled for it in fits of delirium.

The cry of *Water ! Water !* issued from every mouth.

The consequence of this eagerness was, that very little fell to the lot even of those who stood nearest the window; and even these, who were esteemed the most fortunate, instead of finding their thirsts assuaged, grew more impatient.

The confusion soon became general and horrid; all was clamour and contest;—those who were at a distance endeavoured to force their passage to the window, and the weak were pressed down to the ground never to rise again.

Mr. Holwell observing now his dearest friends in the agonies of death, or dead, and inhumanly trampled on by the living, finding himself wedged up so close as to be deprived of all motion, he begged, as the last mark of their regard, that they would for one moment remove the pressure, and allow him to retire from the window, and die in quiet.

Even in such dreadful circumstances, which might be supposed to have levelled all distinctions, the poor delirious wretches manifested a respect for his rank and character: they forthwith gave way, and he forced his passage into the centre of the place, which was less crowded, because, *by this time*, about one third of the number had perished, while the rest still pressed to both the windows.

He retired to a platform at the further end of the room, and lying down upon some of his dead friends, recommended his soul to heaven.

Here

Here his *thirst* grew insupportable; his *difficulty in breathing* increased; and he was seized with a *strong palpitation of the heart*.

These violent symptoms, which he could not bear, urged him to make another effort: he forced his way back to the window, and cried aloud, "*Water, for God's sake!*"

He had been supposed already dead by his wretched companions, but finding him still alive, they exhibited another extraordinary proof of regard to his person: "*Give him water,*" they cried; nor would one of them attempt to touch it until *he* had drank! He now breathed more freely, and the palpitation ceased: but finding himself still more thirsty after drinking, he abstained from water, and moistened his mouth, from time to time, by sucking the *perspiration* * from his shirt sleeves, which tasted soft, pleasant, and refreshing.

The miserable prisoners now began to perceive it was *air* and not *water* that they wanted. They dropt fast on all sides, and a *pungent steam* arose from the bodies of the living and the dead, as *pungent* and *volatile* as *hartshorn* †.

Mr. Holwell being weary of life, retired once more to the platform, and stretched himself by the Reverend Mr. Bellamy, who, together with his son,

* Does the aqueous perspirable fluid contain *oxygen* in looser bond of union than water?

† Did not the superabundant *azot* unite with the *hydrogen* of the body, and form *volatile alkali*?

a young lieutenant, lay dead, locked in each other's arms.

In this situation he was soon deprived of sense, and seemed to all appearance dead, when he was removed by his surviving friends to one of the windows, where the *fresh air* brought him back to life.

The soubah being at last informed that the greater part of the prisoners were *suffocated*, inquired if the chief was alive; and being answered in the affirmative, sent an order for their immediate release, when *no more than 23 survived of 146* who entered into this prison alive*.

Another

* Mr. Holwell, and his surviving companions, were immediately after seized with a *putrid fever*, and in this condition dragged before the soubah to be questioned about a treasure, which he believed they had secreted. This gentleman, having denied the empty assertion, was, with three of his friends, loaded with fetters, and conveyed near three miles to the Indian camp, where they lay a whole night exposed to a severe rain. The next morning they were brought back to the town, chained and suffering the scorching rays of a sun intensely hot. Then large and painful petechiæ came out, and covered their whole body. In this piteous condition they were embarked in an open boat for the capital of Bengal, and underwent such cruel treatment and misery in their passage, as would shock the humane reader should he peruse the particulars. At length the soubah's mother interposed, and he replied, with an unexpected generosity, "*their sufferings have been great, and they shall have their liberty.*"

This fact throws a great light upon the origin of *putrid fever*.—The great and good Dr. Hales, whose studies and experiments

Another melancholy proof of the *necessity of a due supply of air*, may be drawn from the testimony of Dr. Trotter, delivered before a select committee of the *House of Commons*, in the year 1790.

In July 1783, the slave-ship, in which he was, arrived at Cape *La How*, on the Gold Coast of *Africa*. In the space of a week above *one hundred* prime slaves*, *young, stout, and healthy*, were purchased

periments were constantly directed to the benefit of mankind, recommended a trial of *ventilators* in the *Savoy* and *Newgate* prisons, in both of which the *jail fever* was frequent, and commonly fatal: the good effects exceeded even his most sanguine expectations; for a very small portion of the sick died, when the ventilators came into use, and the contagion seemed in a manner arrested. The benevolent Mr. Howard found the prisons on the continent perfectly free from *this pestilential fever*; owing, as he thinks, to the apartments in which the prisoners were confined being spacious, and consequently well aired.

* THE MODE OF OBTAINING SLAVES.—Dr. Trotter says, that the natives of these parts are *sometimes* slaves from *crimes*, but the greater part of the slaves are, *what are called prisoners of war*. Of his whole cargo he recollects only *three criminals*; two sold for *adultery*, and one for *witchcraft*, whose *whole family shared his fate*. One of the first said he had been decoyed by a *woman* who had told her husband, and he was sentenced to *pay a slave*; but being *poor*, was *sold himself*. The last said he had had a quarrel with a *caboshier* (or great man), who *in revenge* accused him of *witchcraft*, and sold *him and his family for slaves*.

Dr. Trotter having often asked Accra, a principal trader at La How, what he meant by *prisoners of war*, found they were such as were carried off by a set of *trepanners and kidnappers*, who *ravage the country for that purpose*. The bush-men making war, to *make trade* (that is, to *make slaves*), was a com-

chased. The competition, however, of the purchasers at *Annamaboe*, whither this ship afterwards sailed, ran so high, that the captain could not obtain more than two thirds of the usual complement. The slaves were confined below sixteen hours out of twenty-four, and permitted no exercise when upon deck. The rooms, where they were secured, are from five to six feet in height. These rooms are imperfectly aired by gratings above, and small scuttles in the side of the ship, which of course can be of little use at sea. The gratings are also half covered, when it blows hard, to keep out the salt spray. The temperature of these rooms was often

mon way of speaking among the traders. Having asked, What they did with their slaves when the nations, who traded for slaves with them, were at war with each other? was answered, That when ships ceased to come, *slaves ceased to be taken*. The practice was also confirmed by the slaves on board, who shewed by gestures how the *robbers* had come upon them.

He once saw a black trader send his canoe to take *three fishermen* employed in the offing, who were immediately brought on board, and put in irons, and about a week afterwards he was paid for them. He remembers another man taken in the same way from on board a canoe along-side. The same trader very frequently sent slaves on board in *the night*, which, from their own information, he found, were *every one of them* taken in the neighbourhood of *Annamaboe*. He remarked, that slaves sent off in the *night*, were not paid for till they had been some time on board, lest, he thinks, they should be *claimed*; for *some were really restored*, one in particular, a boy, was demanded and carried off on shore by some near relations, which boy told him, he had lived in the neighbourhood of *Annamaboe*, and was *kidnapped*.

above

above 96 of Farenheit's scale. In the evidence, of which this is an abstract, Dr. Trotter affirms, he could never breathe there, unless under the hatchways. In such circumstances the sufferings of these poor creatures must have been dreadful. *I have often, says Dr. Trotter, observed the slaves drawing their breath with all the laborious and anxious efforts for life, which are observed in expiring animals, subjected by experiment to foul air, or in the exhausted receiver of an air-pump. I have often seen them, when the tarpawlings have been inadvertently thrown over the gratings, attempting to heave them up, crying out in their own language, "We are suffocated." Many have I seen dead, who the night before have shewn no signs of the smallest indisposition; some also in a dying state, and if not brought up quickly upon the deck, irrecoverably lost.*

Hence, before the arrival of this vessel at *Antigua*, out of 650 slaves more than 50 had died, and about 300 were tainted with the *sea scurvy* *.

Mr.

* This fact throws a great light on the *origin and nature of sea scurvy*, as will be shewn hereafter when treating on that disease. —In our unfortunate expedition to *Quiberon* there were an hundred picked horses put on board a tender. A storm coming on, the hatchways were closed, and these animals remained in this dreadful state above eight and-forty-hours. Ten were found suffocated, and sixty *glandered*, and communicated the disease to other horses when they landed. So sudden and general an infection, Mr. Coleman, the Veterinary Professor, thinks could not have happened from the supposition that a
glandered

Mr. Wilton states, that in his ship, and three others belonging to the same concern, they purchased among them 2064 slaves, and *lost* 586. He adds, that he has known some ships in the slave trade bury a *quarter*, some a *third*, and others even *half* of their cargo *.

To mention no other fact, a strong proof of *the necessity of a frequent renewal of the air*, may be found in the Records of the *Dublin Lying-in Hospital*.

In this hospital 2944 infants out of 7650 died in the years 1782, 1783, 1784, and 1785, within the first fortnight after their birth, that is, nearly *one child*

glandered horse, by some oversight, had been shipped along with the rest, as it requires a week before this disorder could have infected others (as in the small-pox, &c.), and attributes the origin of *glanders*, in this instance, solely from the stived situation in which these poor animals were placed.

* Even on the present regulated plan the situation of the slaves must be dreadful; for their bodies touch each other, and many of them have not room to sit *upright*.

Ye bands of Senators! whose suffrage sways
Britannia's realms, whom either *Ind* obeys;
 Who right the injured, and reward the brave,
 Stretch your strong arm, for *ye have power to save!*
 Throned in the vaulted heart, his dread resort,
Inexorable conscience holds his court;
 With still small voice the plots of guilt alarms,
 Bares his masked brow, his lifted hand disarms;
 But, wrapt in night with *terrors* all his own,
He speaks in thunder when the deed is done.
Hear him, ye senates! Hear *this truth* sublime,
He, who allows oppression, shares the crime.

Dr DARWIN.

out

out of every *six*. They almost all died in convulsions, of what the nurses called *nine-days fits*, because they came on within nine days after their birth. These children, many of them, foamed at their mouths, their thumbs were drawn into the palms of their hands, the jaws were locked, the face was swelled and looked *blue*, as *though they were choaked*.

This last circumstance led Dr. Clark to conclude that the rooms in the hospital were too *close* and *crowded*, and hence the infants had not a sufficient supply of *good air* to breathe. This benevolent physician contrived, therefore, *air-pipes*, 6 inches wide, which were placed in the ceiling of each room. Three holes, an inch wide, were bored through each window frame; and a number of holes were made in the doors at the bottom.

By these contrivances the rooms were kept *sweet* and *fresh*; and the *consequence* has been, from the register in that hospital, that,

Children.

In 1786,	out of 1372	there died	51
1787,	—— 1375	——	59
1788,	—— 1496	——	55
<hr/>			<hr/>
4243			165

Now if out of 4243 children there perish, *when the hospital was ventilated*, only 165 infants, how many

many may be expected to die out of 7650, the number of children born in the *Dublin Lying-in-Hospital* in the years 1782, 1783, 1784, and 1785?

The answer is, by the rule of proportion,—279. But how dreadful the account, there *died* absolutely 2944, that is 2665 solely *from the want of a due supply of air!*—and we have not only to deplore the number of innocent victims, who were destroyed in these few years and previous to them, but also to lament the wretched anguish of the disconsolate parents, and the impoverished state of health in many of the poor babes who survived this great slaughter.

S E C T. XIV.

WHY THE AIR MUST BE RENEWED.

HAVING proved the connexion betwixt *life* and *air*, it is necessary now to shew *what are the chemical alterations air undergoes by being respired.*

Dr. Priestley having formed *nitrous air* by the solution of various metallic bodies in *nitrous acid*, he discovered that it possesses this singular property, that when mixed with *common air*, a great *diminution* of the bulk of the 2 *aerial fluids* takes place, attended with a turbid red, or deep orange colour, and a considerable heat.

I hardly know, says this philosopher, any experiment, that is more adapted to amaze than this, which exhibits a quantity of *air*, which, as it were, devours a quantity of *another kind of air*, half as large as itself, and yet, instead of acquiring *larger dimensions*, becomes itself *considerably contracted*.

We are not so much surpris'd when we find an *aeriform body* starting out from a *solid substance*, as in the formation of *nitrous* and *other factitious airs*; but we are more sensibly affected, when, on the reverse, *two invisible aerial bodies* are converted into a *compact coloured fluid*; for, like condensed steam, they occupy, in *comparison* with their former dimensions,

scarcely any perceptible *space*. Here the *nitrous air* attracts to itself *oxygen*, the base of vital air, *caloric* is given out, and *this combination* gives us *nitrous acid*.

This discovery * was a most agreeable one to me, adds this great experimentalist, as I hope it may be an *useful one* to the public. It is remarkable that *this air* occasions no effervescence or *diminution* with *fixed* or *inflammable airs*, but only with *air fit for respiration and combustion*, and, as far as I can judge, *exactly in proportion to its fitness for that purpose* †; so that by this means the *goodness* of any air may be distinguished much more accurately, than by putting into it a mouse, or any other animal, to try how long it can exist in any given quantity. By *this test* I was enabled to perceive a *real difference* in the air of my *study*, after a few persons had been with me in it, and the air on the *outside of my house*. A phial of air being sent me from the neighbourhood of *York*, it appeared to be not *so good* as the air near *Leeds*; that is, it was not *diminished so much* by an equal mixture of *nitrous air*.

The justly celebrated chemist *Lavoisier*, ascertains

* This fact was known to Mayow, but practically employed as a test of goodness of air *first* by Dr. Priestley.

† That is, in proportion to the quantity of *oxygen air* it contains, which will presently appear to be the *pabulum vitæ*, or *principle of life*. It was shewn in the former part of this work, that *atmospheric air* is a compound of *two distinct* and *solid substances*, *oxygen* and *azot*, rendered *aerial*, by the suspensive power of *caloric*, *fire*.

the proportion of *vital air* * contained in any given quantity of *common air* by the means of *phosphorus*. His *eudiometer* is thus constructed. Having filled a cylindrical glass tube with quicksilver, he immerses it in a basin of the same fluid. He then puts into it *the air*, the purity of which he proposes to examine. He afterwards passes up the *phosphorus*, and having heated an iron wire at the extremity red hot, he applies the hot end to the *phosphorus* through the quicksilver, which quickly consumes †, and the quicksilver *rises* nearly 27 divisions (if the tube has been accurately divided into 100 parts ‡); after

* The reader has already learnt, from the discoveries of Lavoisier, that *atmospheric air* consists of *two parts*, viz. *oxygen air*, blended with *azotic air*, which by chemical means may be separated, and confined in different jars, and that a mouse, or any other animal, will live a considerable time in the *one*, being lively, brisk, and active; whilst, in *the other*, he soon languishes and dies. *This part* of the air, therefore, as so much contributing to *life*, is with the utmost propriety denominated by physicians, VITAL AIR.

† *Phosphorus*, like other combustible bodies, attracts *oxygen*, the particles being once separated beyond their sphere of mutual attraction, or *the attraction of cohesion*. The *caloric*, which is disengaged from the *attracted oxygen*, answers the same purpose as the *hot iron* which first kindled the *phosphorus*. The *phosphorus* becomes in consequence of this union with *oxygen*, *phosphoric acid*.

‡ In 100 parts of atmospheric air, there is most commonly found 27 of *oxygen air*; or, in other words, in 100 gallons of *air*, there would be found 27 gallons of *oxygen air*, and 73 of *azotic air*.

which time, if any *phosphorus* remains, it ceases to burn, there being no more *oxygen* in the tube to be attracted by the *phosphorus* *.

By this means *Lavoisier* ascertained, that when the air out of doors consisted of

27 parts *oxygen air*,
and 73 ——— *azotic air*,

100 parts ;

The air in the lowest ward in the General Hospital at Paris, contained *

but 25 parts of *oxygen air*,
and 71 ——— of *azotic air*,
and 4 ——— of *fixed air*,

100 parts. *

This proportion varied in different parts of the same room. At the top the air had suffered much more injury. It contained

but $18\frac{1}{2}$ parts of *oxygen air*,
and 79 ——— of *azotic air*,

* This clearly evinces that *combustion* is the divorcement of *oxygen* from *caloric*, which being set at liberty, assumes, as it is escaping the character of *flame* or *fire*, for the *phosphorus* no longer burns, than while *oxygen air* is present, and the *phosphoric acid* will have an increase of weight exactly corresponding to the weight of *oxygen air* consumed; that is, 100 parts of *phosphorus* will absorb 154 parts of *oxygen* or base of *vital air*.

and

and $2\frac{1}{2}$ — of *fixed air*,

100 parts.

And when, before the play, the *air* in the theatre in the Thuleries contained

27 parts of *oxygen air*,
and 73 — of *azotic air*,

100 parts ;

Towards the conclusion of the piece, which was acted before an unusual concourse of spectators, it contained

but 21 parts of *oxygen air*,
and $76\frac{1}{2}$ — of *azotic air*,
and $2\frac{1}{2}$ — of *fixed air*,

100 parts.

Whence it is evident, that the *quantity* of *oxygen*, or *vital, air* had been diminished in the theatre in the proportion of 27 to 21, or nearly *one fourth*; that is, it was *one fourth less fit for respiration than before*.

The air of the atmosphere, therefore, which is originally composed of 2 *fluids*, is composed of 3 *aerial fluids*, in all places which contain numerous assemblies of people. *These 3 aerial bodies*, though blended together, arrange themselves in some degree according to their specific gravities ; that is,

the proportion of *azotic air*, which is the lighter body of the three, will be found most in the *upper part*, the *oxygen air* in the middle, and the *fixed air* will be found most in the *lower part* of the apartment.

This occasions a circulation in the air, for, in spite of the architect, the *rarefied air* will ascend, the *fixed air* sink, and the *colder* and *purser air* rush into the apartment through every crevice*.

Unless

* To render the *circulation* of the *air sensible*; if the air of a room be *heated* by fire in it, whilst the air in a contiguous room is *cold*; then let the door between these two rooms be opened, in which case the *hot air* of one room being *rarefied* will pass through the *upper part* of the opening of the door into the cold room; and on the contrary the *cold air* of the other room being *heavier*, will pass into the former through the *lower parts* of the opening. This may be proved by applying a candle at the *top* and *lower parts* of the opening between the two rooms. The direction of the flame of the candle will point out the *contrary currents of air*. It is for this reason that when a fire is lighted in a chimney, a *strong current of air* enters the room, which may be felt by applying the hand near the key-hole, or other small openings, if the doors and windows be shut. It is in this way that a fire is said to purify a room: but this effect is only because the fire promotes the *circulation* of the air, and dries the dampness of the apartment: so that it is not the *infected air* that is purified, but a *new, fresh, and wholesome air*, by the action of fire, that is made to take place of a bad and corrupt air. Hence it appears, that those persons are mistaken who are over-anxious in keeping out the air from entering the apartments of convalescent persons,

Unless *this were the case*, and unless *the air was constantly renewed*, the spectators would be exposed to the most fatal accidents long before the conclusion of the performance.

To convince ourselves of this truth, nothing more is necessary than to take the example of a room, let it be supposed 30 feet long by 25, and 30 feet high.

A room of these dimensions would contain 100 spectators. Now since each person consumes about 5 cubic feet of air in an hour, that is, deprives such a quantity of air of its oxygen air or *vital principle*, it

sons, by *accurately stopping*, by *lift*, *linings*, and *sand-bags*, all the *smallest openings that admit fresh air*.

I cannot forbear mentioning here, as it relates to health, the method for preventing *smoky chimneys*. The particles of air, which are expanded by the fire, being lighter than those particles which are not heated, just as a cork rises, if placed at the bottom of a tub of water, so must the *rarefied air* ascend and pass up the chimney, as being the lighter body of the two. If we conceive the figure of a *French horn*, it is evident that the *volume of air contained in the mouth-piece*, would be *sooner heated* than that at the *base*, and therefore the *rarefaction of air* be more certain, were any given quantity of heat applied to the *smaller* than the *larger portion of air*. It is thus with chimneys, the more they resemble the *French horn*, the more certain the ascent of the smoke, for the *smaller the portion of air* at the bottom, the *sooner* will it be heated, and the *balance* at the *lower and upper parts* of the chimney being destroyed, the *lighter air* cannot but ascend and carry with it the smoke. —The *aperture at the bottom* of chimneys should, therefore, be *small*; and by contracting the chimney-corners also, a greater heat is thrown out into the room.

would follow, that as such a room could contain only 22,500 cubic feet of air, that unless the air was constantly renewed it would be rendered completely mephitic or noxious in about *four hours and an half*, and it is probable that the greater part of the audience would be seriously incommoded, or even perish, long before the end of that period *.

The same calculation applies to all confined places, where a number of persons are assembled together: especially if the air circulates in them slowly, or with difficulty: *the oftener it is respired the more it will become vitiated*; and it is easy to observe how the attention of the audience fails them in such places. They can no longer listen to the discourse. The irritating quality of the mephitic air excites a general coughing. The preacher now receives none of those marks of attention or respect, which in more favourable circumstances he had a right to expect. They experience a drowsy head-ach. They express even a physical anxiety to be gone, and the congregation feel themselves on returning home jaded, and till revived by a *more wholesome or oxygenated air* they look wan, like persons who are ready to faint away.

We now see the reason why Dr. Thornton, in a letter to Dr. Beddoes, the celebrated Professor of

* The affecting narrative of the *Black-hole of Calcutta*, and the *Dublin Lying-in-Hospital*, are melancholy confirmations of the truth of this supposition of Lavoisier.

Chemistry at Oxford, and institutor of the *Pneumatic Practice*, says, that he is persuaded *oxygen gas* would be found of great service, if diffused at certain seasons, in *mines*, in *churches*, in *crowded rooms* *, in

* A lively young lady, who came to *Bath*, to put herself under the care of Dr. Makittrick Adair, gave a rout, and insisted that he should be of the party. The room was *small*, and the company very *numerous*. He had not been long seated at the card-table, before a young gentleman, his partner, *fell into a swoon*. The doors were immediately thrown open to afford him fresh air, and the sash lifted up, and both the gentleman who swooned, and the young lady, Dr. Adair's patient, who were invalids, were much injured by the sudden exposure to a current of cold air. How the rest of the company were affected, says Dr. Adair, I had not an opportunity of knowing; but my own feelings and sufferings for many hours after I retired from *this oven*, convinced me of the *dangerous consequences of such meetings*. On declaring a few days after, to one of my brethren, a man of humour, my resolution of writing a bitter philippic against routs, he archly replied, "Let them alone, Doctor, how otherwise should *twenty-five* physicians subsist in this place!"

If a small tube, opening into the apartment designed for *routs*, was to communicate with the outward air, the external orifice of the tube being made *somewhat above the level of the room*, the fire and breath of the assembly would have no sooner heated the air, than it would rise immediately *upwards*, so as to fill more particularly the higher parts of the room; and, as other particles would be successively heated and rarefied in their turn, by their expansive force they would press upon the upper stratum of air, so as to force the *lightest particles* through the opening left for that purpose in the ceiling of the room, by which contrivance the *foul and hot air* of the apartment would be *gradually drawn off*, and a wholesomer atmosphere left in the room.

But

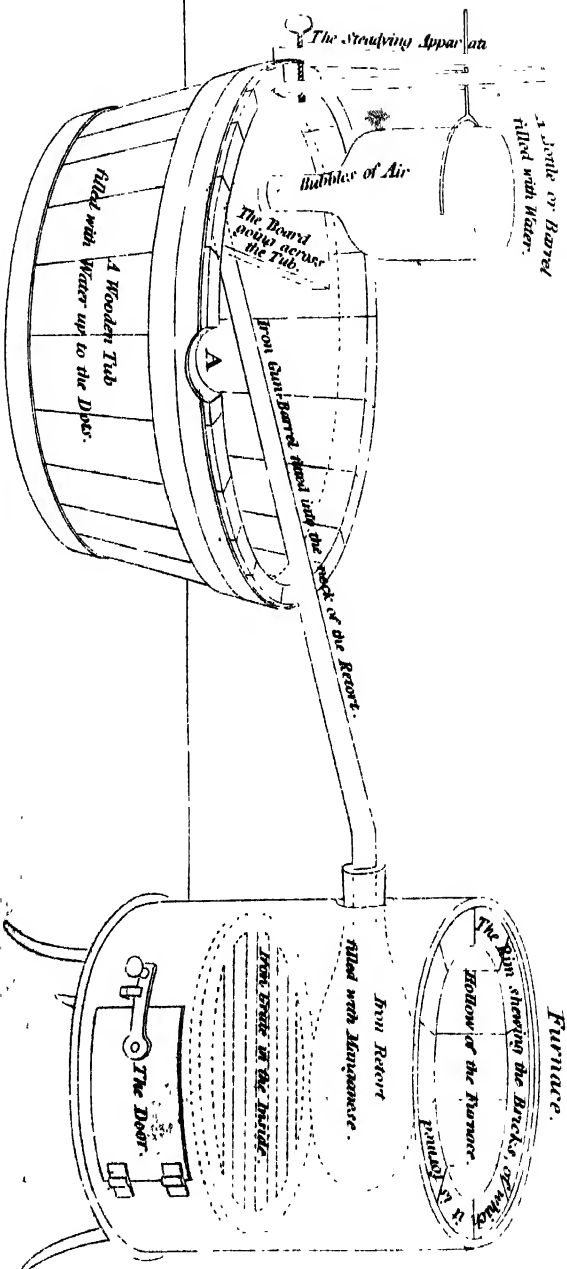
in the *chambers* of the sick, in *hospitals*, and other *public buildings*, and especially in the *bathing-rooms* at Bath, where great *faintness* is often brought on the patients who are bathing by breathing a *reduced atmosphere* from the extrication of *azotic air*, which is given out in a considerable quantity by those waters *.

But in order to *admit fresh air* into the drawing-room, if another opening be made in the ceiling of the room, having a communication with a small pipe that should lead from thence to the outside of the house, and extend *some way beneath the level of the room*: in this situation the *cool external air* would be forced in at the lower opening of the tube, and ascend into the apartment in proportion to the quantity that escaped from the upper region by means of the other tube: and since *weighty air* would no sooner enter the room than it would tend downwards by its own natural gravity, it would gradually be heated by the warm air in its descent, and would thus be dispersed about the room, so as *mildly and imperceptibly* to reach the company and supply them with a sufficient quantity of *fresh and vivifying air*, without any of those inconveniences to which the company are subjected by the usual way of admitting *fresh air*. This simple contrivance might be made as *elegant* as it would be *beneficial*.

The expence and trouble of diffusing *oxygen air* is at present an objection, but let us reflect that in every hundred weight of *minium* or *red lead*, there is combined about ~~10~~ *10 pounds* weight of *oxygen*, or *pure air*. Now as 60 pounds of water are about a cubic foot, and as oxygen air is eight hundred times lighter than water, 500 weight of *minium* or *red lead* should produce *800 cubic feet of oxygen air*, or about 6000 gallons. And, since the substances, which contain *oxygen*, or *vital air*, in immense quantities are of little value, we have a right to expect, that a perfect, salubrious, *pure air*, may, as

chemistry

Mr. Watts's Apparatus for making of Air as simplified by Dr. Thornton.



A. In Hollow to let out the Water by means of a Trough, communicating with an empty Tub.

chemistry advances, be obtained from such materials by a *cheap* and *easy process*.—Dr. Darwin

It has been computed by the Abbé Fontana, that a pound of *nitre*, calcined in a close vessel, yields 12,000 cubic inches of VITAL AIR. 'It is singularly curious that a substance of such very humble pretensions as common *nitre* (salt-petre) should possess properties on which hangs the fate of the most powerful empires' Since by chemistry it may either be converted into a fulminating engine, to overturn fortified cities, and to enable the garriſon to launch out death and destruction on the besiegers: Or,—that by a different process, it may be made to pour forth VITAL AIR, that *vivifying fluid* diffused through the atmosphere, which breathes in the zephyrs, which whippers in the breeze, and which cheers and supports all animated Nature!

How many thousand tons of *nitre* has Europe consumed of late, in making gunpowder, and that with the avowed intention of *destroying* thousands of its inhabitants! Might not a small portion be spared for another purpose, at least equally humane and laudable, viz that of *preserving* an unfortunate fellow creature! Should *the present* advanced price of *nitre*, however, render the preparation of VITAL AIR too expensive a *remedy*, the latter may be obtained by a similar process from *manganese*. Besides, the VITAL AIR from *manganese* has been lately discovered to be of superior quality, and in greater abundance; a circumstance of no *small importance*, now that the demand for VITAL AIR, on account of *medical purposes*, is daily increasing; nor is that to be wondered at, since the new light which it continues to reflect on the *economy*, has already began to dawn on the *pathology*, a circumstance which seems to denote, that a very material REVOLUTION in the practice of physic is at no great distance.—From Dr. Fothergill's admirable Essay, *On the Suspension of Vital Action*, to which was adjudged, by the Medical Society of London, the *prize* of a gold medal.

S E C T. XV.

THE CHEMICAL ALTERATION AIR UNDERGOES BY
BEING RESPIRED.

IT was shewn in the last section, that if an animal be confined under a bell-glass, where all admission of fresh air be denied, the air which before consisted of 2 *aerial fluids*, viz.

1. *oxygen air*,

and 2. *azotic air*,

will presently consist of 3 *aerial fluids* ;

1. *oxygen air*, in a diminished quantity,

2. *azotic air*,

and 3. *fixed air*.

At length the *oxygen air* being consumed, the animal will cease to live, and the air in the bell-glass will be found to consist now of 2 *aerial fluids* only, that cannot maintain life, viz.

1. *azotic air*,

and 2. *fixed air*.

A question naturally arises, *what has become of the oxygen, or vital, air*, deprived of which an animal *dies* ?

OFFICE OF THE LUNGS.

In the lungs the blood coming into contact with *atmospheric air* * works many chemical alterations in it.

Here it is (in the cells of the lungs) that the dark blood, throwing off attenuated *carbon*, forms with the VITAL AIR of the atmosphere,—*fixed air* †:

* “*Respiration* we cannot explain: we only know,” says Dr. Hunter, in his Introductory Lecture which he published in the year 1784, “that it is, *in fact*, essential and necessary to life. Notwithstanding this, when we see all the other parts of the body, and their functions, so well accounted for, we cannot doubt but that *respiration* is so likewise. And IF EVER we should be happy enough to find out clearly the object of this function, we shall, doubtless, as clearly see, that *this organ* is as wisely contrived for an *important office*, as we now see the purpose and importance of the heart, and vascular system; which, till the circulation of the blood was discovered, was wholly concealed from us.” If this learned teacher was to rise from the grave, I believe, no subject would give him higher delight than to behold, issuing from the furnaces of the chemist, a new and simple philosophy, which has clearly developed the *nature* and *necessity* of *respiration*.

† This is proved by making an expiration through a tube containing *lime-water*, which will become instantly *turbid*.—Or if black blood be confined in a phial containing *vital air*, the whole of *that air* will be converted into *fixed air*.

Here

Here it is, that the purple blood parts with its *hydrogen*, which, uniting with the VITAL AIR, forms—the *humid vapour* that issues from the mouth*.

And here it is, that the *dark blood* (having thrown off *hydrogen* and *carbon*) imbibes the VITAL AIR, which changes its *purple colour* to a *brilliant red*.

I. E IMENTS TO PROVE THAT 'PURPLE VENAL BLOOD ABSORBS OXYGEN AIR.

'blood be taken from a *vein*, it readily separates into 2 parts, a thin semi-transparent fluid called *serum*, and the *crassamentum*, floating on it.

This firm substance at first appears of a *dark purple colour inclining to black*, but soon it assumes on its upper surface a *bright scarlet appearance*, resembling the blood contained within *an artery*.

To prove that *this florid colour* is owing to the absorption of *oxygen air* (one of the principles of *common air*), the illustrious Dr. Goodwin enclosed a quantity of *vital air* in a glass receiver inverted over quicksilver, and introduced into it 4 ounces

* This you may prove by placing venal blood in *vital air*, when the sides of the vessel will be covered with large drops of *water*.—Or if black blood be received into a phial containing *azotic air*, *ammoniac* will be formed, which was shewn by Bertholet to be nothing more than *hydrogen* combined with *azot*.

THREE SMALL PORTIONS OF THE LUNGS.

The air cells of the Lungs;

FIG. 1



These cells magnified.

FIG. 2



FIG. 3

FIG. 1. 2. Shew the air cells of the Lungs at the moment of Inspiration, when the blood in the minute vessels covering the air cells, has Imbibed the VITAL AIR, and thrown off CARBON & HYDROGEN

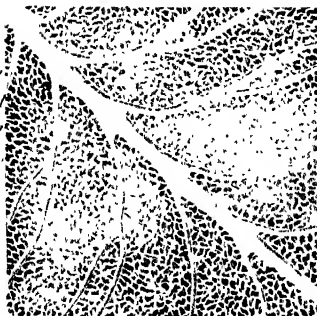


FIG. 3. Shews the air-cells a few moments after Expiration, when a new & dark column of blood pervades the air-cells replete with CARBON HYDROGEN, and devoid of VITAL AIR.

of blood fresh drawn from the *jugular vein* of a sheep: the blood became instantly *very florid*, and the quicksilver seemed to *ascend* a little in the receiver. To ascertain this latter circumstance, I repeated, says he, the experiment three or four times; *the change of colour* in the blood was always *very sudden*, and after several minutes the quicksilver *ascended* two or three lines.

If *oil* be spread on the surface of the blood will prevent the contact of air, no such alteration to colour takes place.

Girtanner, who turned his thoughts much this subject, discovered that *venal blood* not only assumed a *bright vermilion colour* when exposed to *oxygen air*, but gave out *carbon* and *hydrogen*, which uniting with the *oxygen air*, formed *fixed air* * and *water* †, which was found on the surface of the quicksilver.

* *Charnal* and *oxygen air*.

The presence of *fixed air* is ascertained by *lime water*; for water dissolves *lime*, and holds it suspended. The solution then appears perfectly clear and bright. If any *fixed air* comes into contact with the water, the *carbonic acid* seizes on the *lime*, and makes with it a combination *insoluble in water*. The *lime*, in that case, is *visible* in the water. *Lime water* is therefore a test of the presence of *fixed* or *carbonic acid air*.

† *Hydrogen* and *oxygen*.

II. EXPERIMENTS TO PROVE THAT CRIMSON ARTERIAL BLOOD CONTAINS OXYGEN AIR.

The *arterial blood* from the carotid artery of a sheep was received into a bottle full of *azotic air*. The blood from a *bright red* shortly assumed the *deep colour of venal blood*. On opening the bottle the next day, the *azotic air* which it before contained was found mixed with *oxygen air*, so that an animal could live in it, and a candle burnt in it for near two minutes.

This experiment proves decisively that *arterial blood* contains *oxygen air*, and that as soon as it parts with *this air* it then reassumes the true *venal character*.

The *arterial blood* of the carotid artery of a sheep was received into a bottle full of *nitrous air*. The blood assumed a *green colour* * upon the surface. A small quantity of greenish serum was separated. The day after, on opening the bottle, the vapour of *nitrous acid* was observed by all who were present.

* Dr. Girtanner having injected some *nitrous air* into the *vein* of a dog, when it came into contact with the common air admitted into the lungs, *nitrous acid* was formed, and the lungs assumed in consequence a *greenish hue*. The blood returned by the *veins* to the heart was found *black*.

Here then is an experiment which also proves the presence of oxygen air in the arterial blood; since it is from this circumstance alone that it is capable of changing *nitrous air* into *nitrous acid**.

III. DR. GOODWIN'S CELEBRATED EXPERIMENTS.

But that no possible doubt might exist, that *oxygen air* is imbibed by the blood in the lungs, Dr. Goodwin opened the chest of a living dog.

The LUNGS and HEART were then exposed to view.

The blood, which was driven from the *right ventricle* of the heart into the *pulmonary artery* †, appeared of a *dark venous complexion*.

It certainly was a striking spectacle to observe the *black blood*, as it returned from the lungs by the four *pulmonary veins* ‡ of the lungs, in its passage to the *left auricle* of the heart, appear of a *bright vermilion colour*.

It was soon found necessary to inflate the lungs by artificial means.

If at any time this was intermitted, the blood in the four *pulmonary veins* appeared of a *dark purple colour*, and the *left division* of the heart receiving *black blood*, a *diminution* of the pulsations of the heart.

* Vide Sect. XIV. An account of Dr. Priestley's forming of Nitrous Air.

† Vide Map of the Heart, figure (5).

‡ Vide Map of the Heart, figures (8), (9), (10), (11).

and *arteries* took place, and in a little time all *their actions* ceased.

But if at this time the *lungs* were made by the *inflation* of common air alternately to collapse and distend, the blood in the *pulmonary vessels* regained its former *crimson colour*, and the *action* of the *heart* and *arteries* was excited anew*.

Thus, if we open the breast of a frog, and stop the trachea, or windpipe, we observe, first, its pulmonic blood *florid*, and the heart beating strongly; secondly, some time after, the pulmonic blood has become of a *dark colour*, and the heart's motion has grown languid; after this, the pulmonic blood becomes *black*, and the pulsation of the heart ceases; and, lastly, the trachea of the frog being untied, and the creature allowed to breathe again, the blood becomes *crimson*, and the heart acts with its pristine vigour.

* A similar experiment to this was performed by the illustrious Hook before the Royal Society an hundred years ago, when an animal, whose heart was exposed to view, was kept alive a whole hour by the inflation of its lungs. When this was omitted, the heart began to beat slower, and soon ceased all action, the eyes sunk, and the animal became convulsed; but all these symptoms disappeared as soon as the lungs became again inflated with air. An experiment of the same kind is also related by the illustrious John Hunter, which shewed most evidently the connexion of respiration with the colour of the blood and action of the heart. Vide Hunter on Suspended Animation.

SECT. XVI.

THE CIRCULATION OF THE BLOOD

THE immortal Harvey, the pride of our country, was the discoverer of the circulation of the blood. Seeing, says he, that the blood passed from the arteries in abundance into the veins, unless these were to empty themselves, and the others to be re-filled, that ruptures of vessels every where would take place, which does not happen, I began to conjecture, there must be a circular motion of the blood; but this doctrine was so *new* and *unheard of*, that I feared much detriment might arise from the envy of some, and that a number would take part against me, so much does custom and doctrine once received, and deeply rooted, pervert the judgment. However, my resolution was bent to set this doctrine forth, trusting in the candour of those who love and search after truth. In a letter to professor Riolan this great man says, Since the publication of the circulation of the blood, almost no day has passed in which I have not heard both good and evil of my doctrine. Some say that this babe of mine is worthy to be fostered; and that I have by many observations, and ocular testimony confirmed the circulation of the blood. Others think

that it is not as yet sufficiently illustrated, and free from objections; and others again cry out, that I have affected a vain commendation of myself from dissecting of living animals, among which they deride my having made mention of frogs, mice, and other such contemptible creatures, and do not refrain from the most opprobrious language. It cannot be helped, adds Harvey, but that dogs will bark, and cynics pretend to mix with philosophers, but I shall take special care, that they do not bite, and destroy with their dogs teeth the very marrow of truth. They rail against me, because I do not answer the surfeits they have belched up. Detracters, mimics of men; let them know, that I never intend to read works that can have nothing of solid sense in them, much less should I esteem them worthy of an answer. It would be unworthy of me to return opprobrious language for theirs. I shall do better, for *I will overcome opposition by truth*; and if they will consider with me the anatomy of the vilest insect, they will find a God equally in the humbler, as in the higher works of creation.

Such, however, was the power of prejudice, that it is observed by Harvey that no physician passed the age of forty believed in his doctrine, and that his practice declined from the moment he published this ever memorable discovery.

The new doctrine at last getting into some vogue, the
senior

senior physicians, says Malpighi, were inflamed to such a pitch at Bononia, that in order to root out heretical innovations in philosophy and physic, they endeavoured to get an act passed, whereby every graduate should be obliged to take the following *additional clause* to his solemn oath on receiving his degree; “ *You shall likewise swear that you will, with all your might (pro toto tu posse) preserve and defend the doctrines of Hippocrates, Aristotle, and Galen, which are taught in this university, and have been approved of during a long series of ages; and that you will not permit their principles and conclusions to be overturned by any person whatsoever.*”

Here it may be useful, adds the justly celebrated Dr. Hunter, as well as entertaining, to remark, that *improvements* in medicine have always been among men an object of contention. A little reflection on human nature will shew that *vanity* is the principle source of *this absurdity*. All men wish to be respectable; and most of them to pass in the world, *for what they are not*; for being *so very acute, judicious, and learned*, as to need *no new instructions*. Hence professors assume a decided and dictatorial character, affecting to have gone to the *bottom of every thing*, and to have overcome every *difficulty*, either by the natural powers of their understandings, or by the severity of their studies, and perseverance in the pursuit of knowledge. *Old men*, besides, can seldom bear, what they think an inversion of

the natural order or things, that younger persons should instruct them. Of all men, *teachers* of every kind bear this with most impatience. For that reason we see, in fact, that the *seniors of schools, colleges, and public foundations*, have generally been the most obstinate in *shutting out light*, and claiming a *birth-right* for *opinions*, as for *property*. It is easy to see that *such men* will resist *new doctrines* with more obstinacy than the rest of mankind, perhaps with *inveteracy*, in proportion as the doctrines are *well founded* and *readily credited*. They will be sensible that many persons who embrace the *new opinion*, will call to mind *many looks of importance*, and *expressions of vanity*, which must now appear truly contemptible. Dr. Harvey, a few years before his death, had the happiness, however, to find the clamours of ignorance, envy, and prejudice, silenced; and *professional men* grew at last *ashamed* to own, that they had *ever* combated or disbelieved the *circulation of the blood*.

The doctrine taught by Harvey is,

That all the veins of the body falling into *two trunks*, viz. the *ascending* (1), and *descending, cavæ* (2), empty themselves into *the right auricle* of the heart (3). *The right auricle* unloads into *the right ventricle* of the heart (4), which throws the blood through *the pulmonary artery* (5) into *the lungs*, by its *two branches* (6) (7), which go to the *right and left lobes*.

From *the lungs* the blood is brought back by the *four*

four pulmonary veins (8), (9), (10), (11), into the left auricle (12), and from thence it passes into the left ventricle (13), by which it is distributed through the body by means of the aorta (14), and its branches. These terminate in the veins of the body, which collect the blood and bring it back to the heart by the two cava (1) (2). Or, in other words,

That the heart is divided into 2 parts by a longitudinal fleshy separation. These 2 parts are formed into 2 cavities by a lateral membranous valvular separation.

The veins * enter the 2 upper cavities, or auricles, and the arteries † go out from the 2 lower cavities, or ventricles.

When the auricles contract, the blood is driven into the ventricles; and when these contract, it is forced into the arteries.

Then commences, in fact, the double circulation of the blood.—The arteries † contract, and the blood flows from the right division of the heart through the lungs, to enter the left division of the heart:—and from the left division of the heart, the blood passes through the various parts of the body to enter again the right division of the heart.

Such indeed are the admirable organs designed for the circulation of the blood. But how gross does this imperfect sketch fall short of the reality! How incapable are these outlines of expressing the beauties of this noble subject!

* Viz. the two vena cavae, and the four pulmonary veins.

† Viz. the aorta, and the pulmonary artery. Vide Map of

There is in the consideration of *the organs* performing the circulation of the blood, an air of *grandeur* that seizes forcibly on the mind, and penetrates it with the highest admiration*.

Far *less magnificent* their plans, *less skilful* in the execution of them, *hydraulics* offer us but *faint* notions of this miracle, in those machines, by means of which water is distributed into every quarter of a great city.

The works of the CREATOR must be compared to the *emanations* of the same *infinite mind*. Ever like himself, *he* has impressed on all *his* productions a character of nobleness and excellence, which demonstrate their *divine original*.

* When the coloured plates of the heart of the natural size (these represent the front and back view of the heart with the pulmonary vessels) were shewn to that great architect Sir William Chambers, and the circulation there explained was read by him, he held up his hands with astonishment and admiration. These two superb plates, with explanations, published by Dr. Thornton, form the first Number, and are sold by Symonds at ten shillings and sixpence each Number. Mr. Cruikshank in his public lectures always exhibits them to his pupils, recommending them in the strongest terms. They are the commencement of a series of anatomical plates of the size and colour of life, as ports injected, and, as being more permanent and cleanly than the real subject, will meet, we trust, with the countenance of the public at large.

Numbers III. and IV. containing the interior structure of the heart, are in the hands of the Engraver, and will be speedily published. Also Numbers V. and VI. shewing the nerves of the heart, and the vessels of the heart and lungs in their natural situation, will be published in the near future to our view. This work will be completed in twenty numbers, exclusive of the plates and ligatures. The books are not com-

SECT. XVII.

ON THE PULSATION OF THE HEART AND ARTERIES AS DEPENDANT UPON VITAL AIR

Hinc quoque apparet sanguinis *primæ pulsus ex eo ortum ducat*. Nec sanguis solum pars primigenia et principalis dicendus est, quod ab eo motus pulsusque principium oriatur; sed etiam quia in eo primum *color animalis* innascitur, *spiritus vitalis* ingeneratur, et *anima ipsa* consistit. HARV. Exer. 51.

Hence also appears the *pre-eminence* of the blood, that the *pulsation* of the heart and arteries owes its *origin* to it. Nor is the blood to be called the *first mover* and *pre-eminent* for this alone, but because from it springs the *vital heat*, the *animal spirits*, and life itself. Harvey's 51st chapter.

How infinitely near does the immortal Harvey approach the truth, and yet, I believe, he had not the most *distant conception*, that OXYGEN AIR was the *principle* from whose *benign influence* all these *wonderful phenomena* arise.

It is the study of air, and aerial fluids, that has brought to light all the beautiful discoveries which modern physiology can boast of.

In the last section it was shewn, how the blood

was

was a fluid of a rich *vermilion colour* in the *arteries*, and of a strong *purple colour* in the *veins*. When Dr. Goodwin opened the thorax of a living dog, the lungs being collapsed, the heart soon ceased to play, the animal then languished, and seemed expiring, but was revived again when *air* was blown into his lungs: then began again the motion of the heart; the blood receiving the stimulating influence of *vital air*, acted on the left side of the heart, and the right side moved in sympathy *, and the circulation was excited anew, and life continued. Now, this change in the motion of the heart happening so plainly from access of *air*, is a circumstance of the most interesting nature, and obliges us to look into the doctrines of chemistry for the solution of a phenomenon to which there is in the whole animal œconomy nothing to be compared.

On this occasion it is obvious to remark the *importance of the LUNGS*; we perceive that the blood, every time it is *returned* to the *right ventricle* of the

* The right side of the heart pulsates, although it receives only *venal blood*. To solve this difficulty we are obliged to use the word *sympathy*; thus if the nostrils be irritated, the muscles of the diaphragm are thrown into spasmodic action, and an irritation of the stomach brings into action all the abdominal muscles. Thus a disease of the kidney is marked by a numbness along the thigh, a gall stone by vomiting, and a disease of the liver by pain on the scapula. Of the cause of this connexion we are ignorant, and therefore are reluctantly obliged to have recourse to the term *sympathy*.

heart, is directly dispersed through *the lungs*, and immediately reconveyed to the heart, before it is permitted to begin a new circulation; I may add before it is capable of performing a new circulation: for had there been no real necessity, we may boldly assert, this operation of the blood *passing from the right side of the heart through the lungs to the left* would never have taken place. In the study of nature, throughout all her works, however *complex* the machine, the *utility* of each part ever claims the admiration of the speculative mind. This observation is beautifully illustrated on the present occasion; and I believe it will be admitted by every one, that the blood, after having performed *one round* throughout the animal œconomy, undergoes some *new and important change*, in its *transit through the lungs*, essentially requisite to support a *second circulation*. This change is certainly the *oxydation* of the blood, and we should expect, if *oxygen* be the natural stimulus * to the heart and arteries, that their pulsation would be in proportion as the blood had access to this principle. That this is really the case, appears from the following

* As a negative proof, we have those experiments where persons have breathed a reduced atmosphere. One consumptive patient, contrary to my judgment, says Dr. Beddoes, used to inhale at times air wholly deprived of *oxygen*. During this process I have felt the pulse nearly "*obliterated*." He loved to indulge in it, and describes the incipient insensibility produced on him as a state highly delightful. Vide Dr. Beddoes's *Observations*, p. 35.

experi-

experiment, made before a most respectable society of gentlemen, who met once a week at Dr. Higgins's for the purpose of making philosophical experiments. Although Mr. Taylor was not more than 22 years of age, his natural pulse was only 64 previous to the experiment we are about to relate. During the inhalation of 19 pints of *oxygen air*, his pulse, as Dr. Higgins remarked, was quickened to 90 *beats in a minute*, and was considerably increased in *fulness* and *strength*. The vessel being immediately charged again with 19 pints of pure *oxygen gas*, he respired these also, and consumed them entirely in six minutes. His pulse was in consequence increased to 120 *beats in a minute*, and was *vigorous* *withal* *.

* See *Minutes of the Society for Philosophical Experiments* p. 146

S E C T. XVII.

ON THE VITALITY OF THE BLOOD.

THE intimate connexion, which subsists betwixt the life of man, and the air he breathes, was entertained in the remotest ages. Some even suppose that, speaking of the creation, when Moses says, "God breathed into man the breath of life," he alludes to this intimate union, and that "in the image of God created HE man," relates more particularly to the union of soul and body. It is thus with the new born infant; the first thing we do is to infuse into his nostrils "the breath of life." For until the lungs are expanded, and the *venal*, or *purple* blood is changed into *arterial*, or *crimson*, in that organ, the heart does not contract, nor the arteries vibrate; and like a clock, that is not wound up, though sound in all its parts, they remain entirely at rest. In the clock, if we but wind it up, the main spring applying its powers, all the wheels are immediately put into motion, and it marks its hours and its minutes; so likewise in the animal machine, the blood in the lungs having imbibed the *vital principle* of the air, the heart acquires its actions, the brain its energy, the nerves their sensibility, and the other subordinate springs of life presently resume their respective functions.

The

The lady of Dr. Lind, of Windsor, had a child *still-born*. All the common means were tried without effect. Recollecting he had a bladder of *vital air*, with which he was about to make an experiment, he forced this air into the lungs of the infant, when the eddies of its little heart began to play, and the child was restored.

Hence the injunction to the Jews in *Leviticus* against eating blood, “for the *blood* of the animal “is the *life* thereof.” Thus Virgil says in the *Æneid*,

Vitam cum sanguine fudit.

And again,

Unâ eâdemque viâ sanguisq̃ue animusq̃ue sequuntur.

And speaking of the death of Rhoetus, the poet again says,

Purpuream vomit ille animam.

It would be tedious to quote all the suggestions of this sort entertained by the ancient physicians*.

The immortal Harvey was chief among the moderns who taught the *vitality* of the blood. He concludes his fifty-second dissertation with these memorable words: “Inde concludimus sanguinem per “*se vivere*.” “Hence we conclude that the “*blood lives*.” This opinion of the *vitality* of

* Have the ancients named the *arteriæ* from *αἰρ*, the air, supposing these to carry the air to the living body along with the blood, which modern physiology has particularly confirmed?

the blood was however neglected, until it was revived by Hunter *, who taught in his lectures, that the *fluids* as well as the solids were possessed of the *principle of life*. That the blood has *life*, is an opinion, says he, that I have started above thirty years, and have taught it for near twenty years in my lectures ; it does not therefore come out at present † as a *new* doctrine, but has had time to meet with considerable opposition, and also to acquire its advocates. To conceive, that the blood is endowed with *life*, while circulating, is perhaps a

* HUNTER, like HARVEY, presents us with many indications of a great and original mind: he had acute discernment, unwearyed application, original remark, bold inquiry, and a clear, forcible, and manly reasoning, and his name is deservedly illustrious on account of the many observations and improvements he made in anatomy and physiology; and every one who considers the surprise which his doctrines excited among medical men of his day, and the strong opposition they met with, will allow that the opinions he held were novel, or appeared to him new, which entitles him to the first rank in the class of eminent discoverers, ancient or modern. The doctrines of *Pneumatic Medicine* may be found throughout his works, and, like meteors, they often shine forth amid the thick gloom that then pervaded physiology. Once speaking to the author of this work on the subject, HUNTER said, "Whoever shall hereafter investigate the operation of the dephlogisticated, and other airs, in the animal œconomy, and will pursue my ideas of the *vitality* of the blood, he will become a benefactor to mankind, and his name will be immortal."

† Vide his *Work on the Blood*, from which this section is taken nearly *verbatim*.

stretch

stretch of the mind; but the difficulty arises merely from its being a *fluid*, the mind not being accustomed to the idea of a *living fluid*. Let us however weigh the question well, for it is not less difficult for a man born in the West Indies to conceive water as a *solid*. I recollect a person from Barbadoes, walking out with me early one frosty morning, and I observed to him "It was a frost." He immediately caught up the strange word frost, and asked me how I knew it was a frost. "Because," says I, "I see ice." He asked "where." Having shewn him an icicle, he could not believe it had been water, and put his finger upon it, and with such caution, as bespoke a mind ignorant of what he had to meet; and feeling resistance, he drew his hand back; then looking at the ice, he grew more bold, broke it, examined it, saw it melt, and believed it to have been water. Thus when all the circumstances attending the blood are fully considered, the idea that it possesses *life* will be easily comprehended.

First, *living matter has the power of resisting putrefaction*. Our ideas of life have been too much connected with organic bodies, and principally those endowed with visible action, hence it requires some reflection to be convinced, that these circumstances are not inseparable. I was led, says the illustrious Hunter, to this notion in the year 1756, when I was observing the process of incubation. I then noticed, that whenever an egg was hatched, the yolk was always perfectly sweet to the very last; and that

part

part of the albumen, which is not expended in the growth of the animal, some days before hatching, was also sweet, although both were kept in a heat of 103° in the hen's egg for three weeks, and in the duck's for four. I observed, however, that if an egg did not hatch, it became putrid, like other dead animal matter. It is thus with the *blood*: while alive in the body, at the temperature of 97° , it resists putrefaction; but when drawn from a vein, it then putrefies like other dead animal matter.

Secondly, *living matter has the power of resisting the operation of cold*. Having put a new laid egg into a cold about 0 , I imagined that the preserving power of life was destroyed by such a degree of cold. I then put this dead egg, as I shall call it, with one newly laid, into a freezing mixture. The former was frozen seven minutes before the other.

A new laid egg was put into a cold of 15° , it took half an hour before it was frozen, but when thawed, the same being placed under similar circumstances, took only a quarter of an hour, and the same experiment was repeated with nearly the same result.

Similar experiments were made with the *blood*. After a portion of blood had been frozen, and then thawed, it has again been frozen with a similar quantity of fresh blood drawn from the same person, and that which had undergone this process, froze again.

I observed, in
Vol. I.

the sap of trees
would

would freeze at 32° when taken out of the vessel of the tree, but the same was not frozen when the heat of the tree stood often so low as 27° .

Thirdly, *the blood obeys the same laws as the living solids.* The following experiments were made on living muscles, to see how far the *contractions* of living muscles, after having been frozen, corresponded with the *coagulation* of the blood.

From a straight muscle in a bullock's neck, a portion, three inches in length, was taken out immediately after an animal had been knocked down, and was exposed to a cold below 0, for fourteen minutes. At the end of this time it was frozen exceeding hard, was become white, and was two inches long. It was now gradually thawed, and in about six hours after thawing, it was contracted so as to be only one inch in length. Here then were the juices of muscles frozen, so as to prevent all power of contraction in their fibres, without destroying their life, but when thawed, they shewed the same contractile power as before.

This is exactly similar to the freezing of *blood* too fast for its coagulation, which, when thawed, does afterwards coagulate. To prove this by experiment, I took a thin leaden vessel, with a flat bottom, of some width, and put it into a cold mixture below 0, and
 it as covered its
 diately, and

to run from a vein into
 The blood froze immediately, and coagulated.

lated, I think, as soon as it would have done had it not been frozen.

In the spring of 1776, I observed, that the cocks at my country house had the combs smooth with an even edge, and not so broad as formerly; appearing as if nearly one half had been cut off. Having inquired into the cause of this, my servant told me, that it had been common during that winter. He observed that the comb of one cock being frost-bitten had entirely dropt off. I endeavoured to try the solidity of his remark by experiment. I attempted to freeze the comb of a very large cock, and succeeded in freezing the serrated edges, which were fully half an inch in length. The frozen parts became white and hard, and when cut through, neither did it bleed, nor the animal shew any signs of pain. I next introduced into the frigorific mixture one of the cock's wattles, which was very broad and thin. It froze very readily, and upon thawing both the frozen parts of the comb and wattle, they became warm, but were of a purple colour; the wound in the comb now bled freely; both comb and wattle recovered perfectly in about a month, the natural florid colour increased gradually, until the whole had acquired an healthy appearance.

Finding that freezing both the *solids* and the *blood* in them did not destroy the life in either *, nor the

* Leeches may be frozen quite stiff in ice, and dually thawed, they become as vivacious as ever.

future actions of the vessels, and that also it did not prevent the blood from recovering its *fluidity*, I conceived that the life of both solids and fluids are *similar*, and what will affect the one, will affect the other also, though probably not in an equal degree; for in these experiments the blood was under the same circumstances as the solids, and retained its life; that is to say, when the solids and blood were frozen, and afterwards thawed, they both afterwards were capable of carrying on their functions, and were not rejected as extraneous bodies.

It is to me somewhat astonishing, that the idea of the *vitality* of the blood did not early strike medical inquirers, considering the stress which they have laid on the appearance of this fluid in diseases; since this fluid was expressive of disease more than any other part of the animal œconomy, and yet all these changes must have arisen from, what shall I term it? a *dead* animal fluid, on which disease had such an extraordinary power.

While the blood is circulating, we know it has the power of preserving its *fluidity*. This is not produced by motion alone, for in torpid animals, when almost in a state of death during the winter, when the blood is moving with extreme slowness, and would appear to preserve simply animal life through the whole body, the blood does not *coagulate*.

Now, as the *circulation* of the blood appears to be that process which may be best compared with the *action of life* in the solids, we will consider this property

property a little further, and see if this power of coagulation can be destroyed, if it can, we shall next inquire, if by the same means life is destroyed in the solids, and if the phænomena are nearly the same in both.

As the heat of 120 degrees excites the blood to *coagulate*, I wished to try how far *muscular contraction* was similar in this respect. I took a piece of a muscle from a sheep newly killed, and put it into water heated to 120 degrees, when it contracted directly, so as to become hard and stiff.

Animals killed by lightning, and also by electricity, have not their muscles contracted, in such cases the blood does not coagulate. I saw two deer, who were hunted until they dropt down and died; in neither did I find the muscles contracted, nor the blood coagulated. Blows on the stomach kill immediately; and the muscles do not contract, nor does the blood coagulate.

In the West India islands they kill their poultry with vegetable poisons, in order to render them tender without keeping, in which case the blood does not coagulate. For the same reason, the expedient was devised to satisfy shameful gluttony, near the flogging of animals to death.

The general debility, and laxity of the muscles, brought on after repeated venesection, and the great prostration of strength, and even death, produced by hæmorrhage, when the evacuation of the blood is considerably and suddenly made, must be considered

dered as a strong proof, added to the thin state of the blood, of the living principle being inherent in the blood, and of its having a similar nature as the muscular fibres.

On the contrary, in diseases where the action of the heart was going on very strong, the muscles after death contract strongly, and the blood strongly coagulates. This coincidence of coagulability in the *fluids*, and contractility in the *solids*, that is, both shortening their dimensions, and being obedient to the same laws, clearly proves that they both depend on the same cause.

The living principle, therefore, in the *blood*, which I have endeavoured to shew to be similar to the living principle in the *solids*, owes its existence to the same matter which belongs to the other, which is the *materia vitæ diffusa*, of which every part of an animal has its proportion: it is as it were diffused through the whole *solids* and *fluids*, making a necessary constituent part of them, and forming with them a perfect whole; giving to both the power or susceptibility of impression; and, from their construction, giving them consequent reciprocal action.

S E C T. XVIII

THE VITALITY OF THE BLOOD IS DERIVED FROM
THE AIR.

THE *life* of the animal then, says Hunter, arises from the *blood*; but the *blood* itself must be kept *alive*. Whence then the *life of the blood*?

To accomplish this it must have motion to and from the heart; from the heart it is supersaturated, if I may be allowed the expression, with the *living principle*, with which it parts as it visits the different portions of the body.

This *living principle* in the *blood*, which, says Hunter, I have endeavoured to shew was *similar* to the *living principle* of the *solids*, owes its existence to the *same matter* which belongs to the other, and is *that principle* of which every part of an animal has its portion; it is diffused through both solids and fluids, making a necessary constituent part of them, and forming the perfect whole, giving them both the power of preservation from putrefaction, and from cold, and susceptibility of impression, which keeps up the harmony betwixt the fluids and solids, and accounts for that reciprocal influence which each has on the other.

The *materia vite diffusa*, this universal living prin-

ciple, is not, I conceive, derived from the energy of the *brain*, or from *nerves*, for if nerves, either of themselves, or from their connexion with the brain, gave *vitality* to our fluids and solids, how should the circulation continue; and the solids be alive, after a nerve was destroyed? or still more after paralyfis? for the limbs continue alive, blisters draw, wounds heal, parts are nourished, though robbed of voluntary action and feeling; but deprive them of their blood, by tying the arteries, and the parts immediately mortify.

We are come now more particularly to the consideration, *Whence this living principle?*

We are led by daily experience to observe, that the dark blood taken from a vein becomes red on that surface which is exposed to the *common atmosphere*, and that if shaken in a phial with air, the whole becomes red, but *in vacuo*, however shaken, there is no redness. Thus if blood be allowed to stand exposed to the air, and coagulate, its upper surface will become of a scarlet red, while the bottom remains dark. If the coagulated blood be inverted, and the bottom, which has been turned upwards, be exposed to the air, this part will also assume the scarlet red.

The red will even penetrate some depth, and even pervade a distended bladder; so that if venal blood be received into one, and it coagulates, the whole globe will be one uniform scarlet on the outside,

as may be proved by cutting any part of the bladder.

We find also by experiment, the vessels in the lungs being full of blood, are of a dark colour when the trachea is tied; but upon inflating the lungs, the cells will instantly contain florid blood, the small vessels pervading those cells, whether arteries or veins, having the modena colour of the blood immediately changed by the air passing through their coats.

The scarlet blood is therefore that blood which has imbibed air in the lungs, and passes into the arteries, where it is more commonly seen; hence it is called arterial blood, and the modena, or lake, is the venal blood of the body, as also of the pulmonary artery of the lungs. This is so well known that there need hardly any proof of it. I bled a man, continues Hunter, in the temporal artery, and in a vein of the arm at the same time. The blood was received into different cups. The blood of the artery was of a florid red, that from the vein was dark.

To prove that this florid colour arises in the living animal from the absorption of air in *breathing*, I fixed the nozzle of a bellows into the trachea of a dog, and immediately began artificial breathing. I then removed the sternum and cartilages, and opened the pericardium. While I continued the artificial breathing, I observed that the blood in the pulmonary veins and aorta was either crimson, or modena.

just as I threw air into the lungs, or not. I next cut off a piece of the lobe of the lungs, and found that the colour of the blood which came from the bleeding wound corresponded with the experiment above. When I threw air into the lungs, the pulmonary veins and aorta looked red, and scarlet blood issued from the wound; and when I desisted from throwing in air, the blood passing from the wound was of a dark colour.

I bled a gentleman in the temporal artery, while in a fit of apoplexy; he breathed at that time seemingly with great difficulty, the blood flowed freely, but was of a dark venal character; he soon after was relieved, his breathing became free, and the blood from the temporal artery now flowed as crimson as ever.

Mrs. —, of Norris-street, Haymarket, fell into an apoplectic fit, in which she was insensible: the breathing was short, attended with a rattling of the throat, and a snorting. I judged it right to open the temporal artery, and it bled freely; and I observed, that while her breathing was difficult, or when she hardly breathed at all, the blood was modena; and when she breathed easier, the blood became immediately scarlet, and this alternated several times in the course of the bleeding.

A. B. —, when a boy, could never use the same exercise as other boys; he could not run up stairs, nor ascend a hill, without being out of breath. Upon the least motion he had palpitation of the heart.

which was so strong as to be heard by those near him; but his becoming so soon fatigued was supposed by his acquaintance to be owing to a want of spirit. While a child, crying would bring on palpitation, and suffocation; and as suffocation always arises from a want of the due influence of pure air on the blood, while the circulation was going on, the whole body must change from the scarlet tinge to the modena or purple, as was the case, and in particular shew itself in those parts where the blood imparts its colour most, as in the face, lips, finger ends, &c. Nevertheless he grew to be a well formed man, but he still retained those defects, which, indeed, rather increased as he enlarged his views, and with them his actions. He consulted several physicians. The difficulty of breathing, the great oppression, the blackness in the face, I suppose they thought arose from spasm, or was nervous, for they ordered cordials, as spirit of lavender, &c. I was consulted next. Upon investigating all the symptoms, my opinion was, that there was something wrong about the construction of the heart; that in consequence the blood not flowing freely could not have the proper influence of the air in the lungs, hence the reason of the darkness or lividness of the complexion when attacked upon using more exercise than was proper. He was directed, as he could hardly use any exercise of his own, to have motion given him, such as riding in a carriage, and with great care he was directed to suppress such action.

as he found from experience brought on these fits of suffocation. He was to lose a little blood at the time of attack ; but all these precautions hardly kept him tolerably well. At length other disorders supervening, he died, and I had the satisfaction of opening the body. I found the viscera sound, but upon examining the aorta, as it passes from the left ventricle of the heart, I found the aorta, and its three semilunar valves, ossified. This diseased state of the aorta, and its valves, accounts for every one of his original symptoms, and as such afford very little use to the practitioner in order to accomplish a cure ; the blood there, upon any unusual extension, must have fallen back into the ventricle, and have overloaded the heart, impeding the circulation, and consequently the necessary change of blood in the lungs.

The vast number of cells into which the lungs are divided, the whole arterial and venal system ramifying on the surface of those cells, and of course the whole of the blood passing through them in every circulation, together with the loss of life upon missing three or four breathings, shew the power of the air upon the purposes of life ; and the time we can live without breathing, being shorter than that in which we can die from a defect in any other natural operation, all seem to prove, that the air somehow bestows life on the blood, and the blood continues it, by the same vital principle to every part of the body. — so it is to the atmosphere (or rather to that particular part of

it which goes by the name of *vital*, or *oxygen air*) that we are indebted for *that vitality* which is communicated to the *blood*, and which *animates* our *bodies*, and is the immediate bond of union betwixt our immaterial soul and this visible world.

We may be compared to small pieces of feather placed upon an electrical machine, which while the handle is turned, dances upon the conductor, but the moment of cessation, they all drop: so we are supported upon this solid globe, and each plays his part; but were once the air to be removed we should immediately fall down, as those stricken in the deserts of Arabia by the Hattan or scorching wind.

Respirable air, says John Hunter, has the property of heightening the red colour of the blood to a scarlet; and *this*, with its consequent *beat*, is supposed to be the chief or only use of *respiration*:—but if we suppose the change of colour in the red globules to be all that *respiration* is to perform, we shall make the *red globules* the most essential part of the blood, whereas that may be said to be the least. It is most probable, that *the effect* of air on *the blood* is greatest on the *coagulable lymph*; and this conjecture is rendered more likely, when we consider, that in cold animals, which have no red globules, *respiration* is as essential to their existence as in any other.

Having at hand some water from the hot-well at Bristol, which I had found to contain air in a state of great purity, I completely filled a large phial of

it, and I put into it a few very small fish, which I had provided for the purpose of these experiments. They were minnows, and other small fish about two inches in length. In this water they were confined without any access of common air till they died.

After this I took equal quantities of the water in which the fish had died, and of that out of which it had been taken, where they were confined in; and I expelled from both all the air which they would yield. That from the water in which no fish had been put, exceeded in quantity that from the water in which they had been confined, in the proportion of 3 to 2; and examining the quality of both these quantities of air, by the test of nitrous air, the former exceeded the latter in a still greater proportion.

The air from the water in which no fish had been confined was at the standard of common air, but that which had been contaminated by the respiration, as I must say, of the fish, was something *worse* than air in which a candle just goes out.

From this experiment it may be concluded with certainty, that *air* contained in *the interstices* of water, is as necessary to the life of *fish*, just as *air* in its *aeriform state* is to that of all *land animals*.

The blood, therefore, possesses vitality in all its parts, and this vitality, which it communicates to the solids, is derived from the oxygen of the

S E C T. XIX.

LIFE OF JOHN HUNTER.

JOHN HUNTER was the son of John and Agnes Hunter, of Kilbride, in the county of Lanerk; he was the youngest of ten children, and was born on the fourteenth of July, 1728, at Long Calderwood, a small estate belonging to the family. His father was descended from Hunter of Hunterston, an old family in Ayrshire, and his mother was the daughter of Mr. Paul, a very respectable man, and treasurer of the city of Glasgow.

John Hunter was about ten years old at his father's death, and was left under the direction of his mother, who was particularly indulgent to this her youngest son. He was sent to the grammar-school, but not having a turn for languages, nor being sufficiently under controul, he neglected his studies, and spent the greatest part of his time in country amusements.

About this time Mr. Buchanan, who had lately come from London to settle at Glasgow as a cabinet-maker, paid his addresses to Mr. Hunter's sister Janet, and having many agreeable qualities, she was induced to marry him.

Mr. John Hunter, when at the age of seventeen, went

went to Glasgow upon a visit to his sister, for whom he had the greatest affection, and followed this business; but disgusted, probably, by so servile and mechanical an occupation, he shortly after returned to his mother.

Tired, however, of living idle in the country, he began to turn his mind to some active employment; and hearing much of the reputation which his brother Dr. William Hunter had acquired as a teacher of anatomy, he wrote up to request that he would allow him to come to London upon a visit, making at the same time an offer to be his assistant in his anatomical researches; or, if that proposal should not be accepted, expressing a wish to go into the army.

In answer to this letter, he received a very kind invitation from his brother, and immediately set off for London, accompanied by Mr. Hamilton, a friend of the family who was going upon business; they rode up together on horseback.

Mr. Hunter arrived in London in September, 1748, about a fortnight before his brother began his course of lectures; and from this period we may consider Mr. Hunter as being seriously engaged in anatomy, and, under the instructions of his brother and his assistant Mr. Symonds, he had every opportunity of improvement, as the chief dissections at this time carried on in London were confined to that school.

In the summer 1749, Mr. Cheffelden, at the request

quest of Dr. Hunter, permitted him to attend at Chelsea Hospital, and he there learnt the first rudiments of surgery.

The following winter he was so far advanced in the knowledge of human anatomy, as to instruct the pupils in dissection, to whom Dr. Hunter had very little time to pay attention. This office, therefore, fell almost entirely upon him, and was his constant employment during the winter season.

In the summer months of 1750, Mr. Hunter attended the hospital at Chelsea; in 1751, he became a pupil at St. Bartholomew's, and in the winter was present at operations occasionally, whenever any thing extraordinary occurred.

The following summer he went to Scotland, and brought up his sister Dorothea, and in 1753 entered as a gentleman commoner at St. Mary Hall, Oxford.

In 1754, he became a surgeon's pupil at St. George's Hospital, where he continued during the summer months, and in 1756 was appointed house-surgeon.

In the winter 1755, Dr. Hunter admitted him to a partnership in his lectures, and a certain portion of the course was allotted to him, besides which, he gave lectures when the doctor was called away to attend his patients.

Making anatomical preparations was at this time a new art, and very little known; every preparation, therefore, that was skilfully made, became an

object of admiration; many were wanting for the use of the lectures, and the doctor having himself an enthusiasm for the art, left no means untried to infuse into his brother a love for his favourite pursuits. How well he succeeded, the collection afterwards made by Mr. Hunter will sufficiently evince.

Many parts of the human body being so complex, that their structure could not be understood, nor their uses ascertained, Mr. Hunter was led first to examine similar parts in other animals, in which the structure was more simple, and more within the reach of investigation; this carried him into a wide field, and laid the foundation of his vast collection in comparative anatomy.

The collection of comparative anatomy which Mr. Hunter has left, and which may be considered as the great object of his life, must be allowed to be a proof of talents, assiduity, labour, and original genius. The idea appeared too vast for man. Of him it may with juster propriety be said than of any other man, "*Deus creavit, Hunterus disposuit*;" whose genius cannot be contemplated without surprise and admiration.

In this collection we find an attempt to expose to view the gradations of nature, from the most simple state in which life is found to exist, up to the most perfect and most complex of the animal creation—man himself.

By the powers of his art, this collector has been enabled so to expose, and preserve in spirits or in a dried state, the different parts of animal bodies

dies intended for similar uses, that the various links of the chain of perfection are readily followed and may be clearly understood.

This collection of anatomical facts is arranged according to the subjects they are intended to illustrate, which are placed in the following order :

First, parts constructed for motion.

Secondly, parts essential to animals respecting their own internal œconomy.

Thirdly, parts superadded to purposes connected with external objects.

Fourthly, parts relative to the propagation of the species and maintenance or support of the young.

The FIRST CLASS exhibits the sap of vegetables and blood of animals, from which fluids all the different parts of the vegetable and animal creation are formed, supported, and increased. These fluids being more and more compounded, as the vegetables and animals become more perfect, are coagulated and form a regular series. The sap of many plants does not coagulate spontaneously, but is made to undergo this change by adding the extract of Gowlard, in this respect differing from water : the sap of such plants is considered as the most simple : in the onion there is a spontaneous coagulation : in insects the blood coagulates, but is without colour : in the amphibia, colour is superadded.

The moving powers of animals, from the simple straight muscle to the most complicated structure

of that organ, with the different applications of elastic ligaments, form a *second series*.

The growth of bone, horn, and shell, come *next in order*; and the joints which admit of their moving readily on one another, *finish* this subject.

THE SECOND CLASS begins with those animals of the hydatid kind, which receive nourishment, like vegetables, from their external surface, having no mouth.

Then follow those which are simply a bag or stomach, with one opening, as the polypus, having no organs of generation, as every part of the bag is endowed with that power; but in the leech the structure becomes more complex, for although the animal is composed of a bag with only one opening, the organs of generation, brain, and nerves, are super-added, and thence a gradual series is continued to those animals in which the stomach forms only a distinct part of the animal, for the purpose of digestion.

The stomachs themselves are also arranged in the order of their simplicity.

First, the true membranous digesting stomach, then those with the addition of crops, and other bags, to prepare the food for digestion, as in the ruminating tribe, and, lastly, those with gizzards.

Annexed to the stomachs, is a very complete and extensive series of teeth, which are varied according to the kind of food and stomach.

After

After the stomachs are the different appearances of the intestinal canal, which exhibit almost an infinite variety in the structure of their internal surface from which the aliment is absorbed.

The quantity of surface is increased in some by transverse folds, in some by spiral or longitudinal ones, and in others puts on a loculated appearance, as in the whale.

To these are added the glands, connected with the intestines, as the liver, pancreas, and spleen, which may properly be considered as appendages.

After digestion, follows the system of absorbing vessels, the simplest being the roots of plants, after which are the lymphatic and lacteal vessels of different animals.

These in the human subject and the elephant are small, and in the turtle large and more numerous; but in the spermaceti whale, where they are employed for conveying the spermaceti, of a size infinitely beyond what is met with in any other animal. To these are annexed the thoracic ducts in different animals.

The natural order, in following the course of the aliment from the stomach as a guide, leads from the absorbents to the heart, which in the caterpillar is a simple canal or artery running along the middle of the back of the animal, admitting of undulation of the blood; from this simple structure it becomes, in different animals, by small additions, more and more complex, till it arrives at the degree of per-

fection which is displayed in the organization of the human heart.

These are followed by the different structures of valves in the arteries and veins, and the coats of these vessels.

Then the lungs are shown in all their gradations from the simple vascular lining of the eggshell, which serves as lungs for the chicken, to those of the more perfect animals.

In one instance, viz. that of the fyren, both gills and lungs are seen in the same animal.

The windpipe and larynx are then shown, under all their different forms.

The kidneys, which separate the superfluous fluids from the circulation, make the last part of this subject.

The THIRD CLASS takes up the most simple state of the brain, which is in the leech a single nerve with ramifications.

In the snail, the brain forms a circular nerve, through the middle of which passes the œsophagus, from which circle there are branches going to every part of the skin of the animal.

In the insect, the brain has a more compact form, is larger in fish, but still more so in birds, gradually increasing in size as the animal is endowed with a greater degree of sagacity, till at last it becomes the large complex organ found in the elephant and in the human subject.

The

The coverings of the brain, and the ganglions and peculiarities of the nerves, are annexed.

The organs of sense are arranged in the order of their simplicity, beginning with that of touch, which is only a villous vascular surface, the villi very short where the impression is to be made through a thin cuticle, as in the human finger; very long where the covering is thick, as the hoof of the horse.

The organ of taste is only a modification of touch, and therefore nothing in the organization is different, but the varieties in structure adapting the tongue for different purposes are numerous; in many animals it answers the purpose of a hand, to bring the food to the mouth, as in many shell-fish, the ant-bear, woodpecker, and camelion. Connected with the tongue are the fauces, which in many animals have peculiarities; in the electric eel, they have a very curious carrunculated irregular appearance; but they are yet more extraordinary in the camel, which has an apparatus to moisten the parts, so as to prevent the painful sensation of thirst, thus adapting the animal to the sandy deserts which it is destined to inhabit; this apparatus consists of a large bag hanging down several inches in the fauces, and attached to the palate, which the animals can at pleasure move up and down, and lubricate the fauces.

The organ of smell is variously constructed, and is more complicated in many animals than in man, as in the lion, and sea-cow. The organ of hearing

in fish consists of three semicircular canals; but is much more complex in land animals.

The organ of seeing is different in those animals which are formed to see in water, and in those which see in air; it differs again in those which are to see with little or with much light; all those peculiarities are illustrated by preparations. The pigmentum of the eye in some fish resembles polished silver; in ruminating animals at the bottom of the eye it has a greenish hue, in the lion and cat kind, a portion of the bottom is white; but, as a general principle, the colour of the pigmentum is the same as the rete mucosum of the skin of the animal, being white in white animals, and black in very dark ones.

After the brain and senses are arranged the cellular membrane and animal oils, which are followed by the external coverings. These are divided into the different kinds, as hair, feathers, scales, &c. with the rete mucosum, or that membrane which is interposed between the true skin and the scarf-skin, for the purpose of giving the peculiar colour. Added to these are the parts peculiar to different animals, for offence and defence, as spurs, hoofs, horns, stings, and also electric organs. There follow next such peculiar structures as occur in certain tribes of animals, as the air-bladders in fish, &c.

Besides the preparations of themselves in spirits, in a dried state or corroded, so as to give the most accurate

accurate ideas of their structure of parts, there is a considerable number of very valuable drawings in this collection to show the progress of different processes in the animal œconomy, together with such appearances as were not capable of being preserved.

This sketch will give an idea, but a very inadequate one, of the system which is comprehended in Mr. Hunter's collection.

It also includes a very large series of whole animals in spirits, arranged according to their internal structure, and many of the most rare specimens of preserved animals in this country, as the camelopardos, guanica, hippopotamus, tapir, argus-pheasant, &c.

There is also a series of skulls of different animals, to show their peculiarities, and skeletons of almost every known genus of animals.

There is a large collection of shells and insects; a prodigious number of calculi of different sorts from the urinary and gall-bladders, the stomach, and intestinal canal; there are likewise the most uncommon deviations from the natural structure, both in man and in other animals, preserved in spirits or in a dried state; the most extraordinary specimens of this kind are, a double human skull perfectly formed, the one upon the top of the other.

To make this collection more complete in every subject connected with comparative anatomy, is added one of the largest and most select collections

tions of extraneous fossils that can be seen in this country *.

His health was so much impaired by excessive attention to his pursuits, that in the year 1760 he was advised to go abroad, having complaints in his breast, which threatened to be consumptive. Therefore in October of that year, Mr. Adair, inspector-general of hospitals, appointed him a surgeon on the staff; and in the following spring he went with the army to Bellisle, leaving Mr. Hewson to assist his brother during his absence.

Mr. Hunter served, while the war continued, as senior surgeon on the staff, both in Bellisle and Portugal, till the year 1763; and in that period acquired his knowledge of gun-shot wounds; a subject which makes no inconsiderable part of his invaluable performances.

On his return to England he settled in London;

* This museum, the grandest in the world, raised by the industry of an individual in a short life, which would have conferred even an honour on an age, and that uncommonly industrious, was at the death of its owner eagerly sought after by foreign courts. The king of Spain made an unlimited offer to the family of John Hunter: but the British Parliament wished to secure to this country so invaluable a possession, and twenty thousand pounds is the sum allotted for the purchase of this museum, so honourable to the founder and the nation. This sum has not, however, been as yet advanced, and the widow and two sons of Hunter have experienced, it is hoped, only a temporary inconvenience.

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where not finding the emoluments from his half-pay and private practice sufficient to support him, he taught practical anatomy and operative surgery for several winters.

He pursued, with unabated ardour, comparative anatomy, and as his experiments could not be carried on in a large town, he purchased, for that purpose, about two miles from London, a piece of ground near Brompton, at a place called Earl's Court, on which he built a house.

One day two leopards, which were kept chained in an out-house, had broken from their confinement, and got into the yard among some dogs, which they immediately attacked; the howling this produced, alarmed the whole neighbourhood; Mr. Hunter ran into the yard to see what was the matter, and found one of them getting up the wall to make his escape, the other surrounded by the dogs; he immediately laid hold of them both, and carried them back to their den; but as soon as they were secured, and he had time to reflect on the risk of his own situation, *he was so much agitated that he was in danger of fainting* *.

On the fifth of February, 1767, he was chosen a Fellow of the Royal Society. His desire for improvement in those branches of knowledge which might assist in his researches led him at this time to propose to Dr. George Fordyce, that they should

* This is supposed to have laid the foundation of the complaint of which he died.

adjourn from the meetings of the Royal Society to some coffee-house, and discuss such subjects as were connected with science. This plan was no sooner established, than they found their numbers increased; they were joined by Sir Joseph Banks, Dr. Solander, Dr. Maskelyne, Sir George Shuckburgh, Sir Harry Englefield, Sir Charles Blagden, Dr. Noothe, Mr. Ramsden, Mr. Watt of Birmingham, and many others. At these meetings discoveries and improvements in different branches of philosophy were the objects of their consideration; and the works of the members were read over and criticised, before they were given to the public.

In January 1776 Mr. Hunter was appointed surgeon-extraordinary to his Majesty, and in the spring he gave to the Royal Society a paper on the best mode of recovering drowned persons.

In 1781, he was elected a Fellow of the Royal Society of Sciences and Belles Lettres at Gottenburgh.

In 1783, he was chosen into the Royal Society of Medicine, and Royal Academy of Surgery, in Paris.

In this year the lease of his house in Jerminy-street having expired, and his collection being now too large to be contained in his dwelling-house, he purchased the lease of a large house on the east side of Leicester-square, and the whole lot of ground extending to Castle-street, on which there was another house. In the middle space between the two houses

he erected a building for his collection. Upon this building he expended above three thousand pounds. In excuse for so inconsiderate a transaction, it can only be said, that the difficulties he had met with in finding ground in an eligible situation, had harassed his mind, already too much occupied, to such a degree, that he was glad to be relieved from that embarrassment, and sacrificed the interest of his family, for the lease did not extend above twenty years.

In the building formed for the collection there was a room fifty-two feet long, by twenty-eight feet wide, lighted from the top, and having a gallery all round, for containing his preparations. Under this were two apartments; one for his lectures, and the other, with no particular destination at first, but afterwards made use of for weekly meetings of medical friends during the winter.

During the execution of this extensive plan I returned, says Mr. Home, his brother in law, to England from Jamaica, where at the close of the war I had been appointed staff surgeon. Sir Archibald Campbell, the governor, coming home, gave me leave of absence on account of my health, and allowed me to attend him.

I found Mr. Hunter, says he, now advanced to a very considerable share of private practice, and a still greater share of the public confidence. His collection kept increasing with his income. In this he was materially assisted by the friendship of Sir Joseph Banks; who not only allowed him to take any
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of his own specimens, but procured him every curious animal production in his power, and afterwards divided between him and the British Museum all the specimens of animals he had collected in his voyage round the world. To his friends, the honourable Mr. Charles Greville and Mr. Walfsh, he was also under particular obligations.

Drawing materials from such ample sources, standing alone in this branch of science, and high in the public estimation, he had so much attention paid to him, that no new animal was brought to this country which was not shewn to him; many were given to him; and of those that were for sale he commonly had the refusal: under these circumstances, his collection made a progress, which would otherwise have been impossible.

At this period Mr. Hunter may be considered as at the height of his chirurgical career; his mind and body were both in their full vigour. His hands were capable of performing whatever was suggested by his mind; and his judgment was matured by former experience. He was, at this time, engaged in a very extensive private practice; he was surgeon to St. George's Hospital; he was giving a very long course of lectures in the winter; he was carrying on his inquiries in comparative anatomy; had a school of practical human anatomy in his house; and was always employed in some experiments respecting the animal œconomy.

Being always solicitous for some improvement
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in medical education, he, with the assistance of Dr. Fordyce, instituted a medical society, which he allowed to meet in his lecture-rooms, and of which he was chosen one of the patrons. This society, called the *Lyceum Medicum Londinense*, under his auspices, and those of Dr. Fordyce, has acquired considerable reputation, both from the numbers and merits of its members.

In the spring of this year he had a very severe illness, which confined him to his bed, and rendered him incapable of attending to any kind of business.

After his recovery from this illness, he was subject to affections of the heart, upon every occasion which agitated his mind, or required any sudden exertion of the body.

In July 1787, he was chosen a member of the American Philosophical Society.

His collection, which had been the great object of his life, both as a pursuit and an amusement, was now brought into a state of perfect arrangement; and he had at length the satisfaction of giving to the public a series of anatomical facts formed into a system, by which the œconomy of animal life was illustrated. He shewed it to his friends and acquaintances twice a year, in October to medical gentlemen, and in May to noblemen and gentlemen, who were only in town during the spring. This custom he continued to his death.

Upon the death of Mr. Adair, which happened in 1792, Mr. Hunter was appointed inspector-general

general of hospitals, and surgeon-general of the army. He was also elected a member of the Royal College of Surgeons in Ireland.

In the year 1791, he was so much engaged in the duties of his office, as surgeon-general to the army, and his private practice, that he had little time to bestow upon his scientific objects; but his leisure time, small as it was, he wholly devoted to them.

In 1792, he was elected an honorary member of the Chirurgo Physical Society of Edinburgh, and was chosen one of the vice-presidents of the Veterinary College, then first established in London.

Earl's Court to Mr. Hunter was a retirement from the fatigues of his profession; but in no respect a retreat from his labours; there, on the contrary, they were carried on with less interruption, and with an unwearied perseverance. From the year 1791 till his death, he made it his custom to sleep there during the autumn months, coming to town only during the hours of business in the forenoon, and returning to dinner. It was there he carried on his experiments on digestion, on exfoliation, on the transplanting of teeth into the combs of cocks, and all his other investigations on the animal œconomy, as well in health as in disease. The common bee was not alone the subject of his observation, but the wasp, hornet, and the less known kinds of bees, were also objects of his attention. It was there he made the series of preparations of the external and internal

nal changes of the silk-worm; also a series of the incubation of the egg, with a very valuable set of drawings of the whole series. The growth of vegetables was also a favourite subject of inquiry, and one on which he was always engaged in making experiments.

In this retreat he had collected many kinds of animals and birds, and it was to him a favourite amusement in his walks to attend to their actions and their habits, and to make them familiar with him. The fiercer animals were those to which he was most partial, and he had several of the bull kind from different parts of the world. Among these was a beautiful small bull he had received from the Queen, with which he used to wrestle in play, and entertain himself with its exertions in its own defence. In one of these contests the bull overpowered him, and got him down, and had not one of the servants accidentally come by and frightened the animal away, this frolic would probably have cost him his life. It produced spasms about the heart.

JOHN HUNTER, in the latter period of life, had a disease of the heart, connected with gout, an account of which he gave in his book on the Blood during his life-time. To prevent the hurry of the circulation he drank water, which did not suit his gout; and when treated for the gout, he always found himself much distressed by stimulant medicines: which circumstances may have led him to think less highly of physic than the art deserves.

His temper was naturally warm, and he constantly dreaded the effects of passion, which increased both diseases.

An instance of the effects of passion over him :— One day he was going to Westminster-hall with Mr. Heavyside, surgeon to the king, to hear a trial; the stand of coaches in Palace-yard intercepted his passage, and he bid one of the coachmen to make way for him. The fellow refused, and became insolent, and John Hunter losing all temper, gave vent to the most terrible execrations, which only produced laughter in the other; and poor Hunter was obliged to go the whole length of the stand, all closing the tighter their ranks. When he arrived in the Hall, he sat himself down, saying, The rascals have killed me; and Mr. Heavyside supported him in his arms, expecting every moment to see the first anatomist in the world expire in this untoward situation.

On October 16, 1793, says his biographer *, when in his usual state of health, he went to St. George's Hospital, and unexpectedly meeting with some things that ruffled his temper, he allowed himself to give way to passion; the heart became overloaded with blood, the ossified aorta † not yielding to the effort of the heart, the countenance became dark, angina pec-

* Mr. Home, his brother-in-law, a surgeon of considerable eminence.

† This was found to be the case upon dissection after his death.

toris immediately ensued, and turning round to Dr. Robertson, one of the physicians of the hospital, he was incapable of utterance, and died. Thus perished the greatest anatomist and physiologist of this age, whose premature death must be ever lamented by all those who know of how great value, and how scarce, such a genius as his was: for when shall we see his like again!

Mr. Hunter was of short stature, uncommonly strong and active, very compactly made, and capable of great bodily exertion. His countenance was animated, open, and in the latter part of his life deeply impressed with thoughtfulness. When his print was shewn to Lavater, he said, "That man thinks for himself."

His temper was very warm and impatient, readily provoked, and when irritated, not easily soothed. His disposition was candid, and free from reserve, even to a fault. He hated deceit; and, as he was above every kind of artifice, he detested it in others, and too openly for his own advantage avowed his sentiments. His mind was uncommonly active; it was naturally formed for investigation. He required less relaxation than most men; seldom sleeping more than four hours in the night.

To his own abilities alone he was indebted for the eminence which he acquired in his profession; for although his medical education, his situation as surgeon at St. George's Hospital, and, above all, his brother's recommendation, entitled him to notice, yet

the increase of his private practice was at first but slow. The natural independence of his mind led him rather to indulge in his own pursuits, than to cultivate the means of enlarging the sphere of his business; but the proofs which he afterwards gave of his talents commanded the attention of the public, and procured him a very liberal income.

In private practice he was liberal, scrupulously honest in saying what was really his opinion of the case, and ready upon all occasions to acknowledge his ignorance whenever there was any thing which he did not understand.

In conversation he spoke too freely, and sometimes harshly of his contemporaries; but if he did not do justice to their merits, it arose not from envy, but from his thorough conviction that surgery was as yet in its infancy, and he himself a novice in his own art; and his anxiety to have it carried to perfection, made him think meanly and ill of every one whose exertions in that respect were not fully exerted like his own.

S E C T. XX.

L I F E O F L A V O I S I E R.

LAVOISIER was born at Paris, August 26, 1743. His father, who was very opulent, paid an extraordinary degree of attention to his education, and the young man profited greatly by the instructions bestowed upon him. After having studied the classics, and entered on jurisprudence, he afterwards cultivated the sciences merely from his love of them, and without any fixed object.

In 1764 the government proposed, as the subject of an extraordinary prize, the solution of the question relative to the best mode of lighting the streets of a great city during the night, and combining together the several properties of economy, distinctness of vision, and facility of operation. The sum of 2000 livres (about 83l. sterling, proffered as a reward upon this occasion, was distributed among three artists, who had expended some money in experiments: the person who had treated this subject scientifically was distinguished in a different manner; for the academy ordered the memoir of Lavoisier to be printed, and he received a gold medal from the king, which was presented to him by the president, in a public assembly, on the 9th of April

1766. The dissertation in question, which is replete with mathematical and philosophical researches, already announced that the author had commenced the career of the sciences; and, indeed, he never ceased to distinguish himself from that epoch.

On the 10th of May, 1768, he was elected by the academy to supply the place of Baron; he happened to be a candidate at the same time with Jars, an able mineralogist, enjoying the protection of the great, and in whose behalf both Buffon and Trudaine interested themselves; the minister also declared in his favour, for he placed Jars first on the list, although he was only second in respect to votes. The majority contributed to the election of Lavoisier, although younger and less celebrated than his rival, from the consideration that one at his time of life, who possessed such knowledge, talents, and activity, and whose fortune rendered it unnecessary for him to exercise any profession, would become exceedingly useful to the sciences: it accordingly happened that his wealth was always devoted to the advancement of knowledge.

About the same time he published various dissertations in the journals, relative to the project, Yvette*, thunder, the aurora borealis, and the

* Le Projet de l'Yvette. Orig. This was a scheme for supplying Paris with water, from the neighbouring village of Yvette, a few miles distant from the capital, in the same manner as London is supplied by means of the River.

cess of congelation in the passage from water to ice.

He also travelled along with Guetard, who devoted his time to the study of the natural history of his native country; whence resulted a manuscript mineralogical chart of France, which is nearly completed; and also a dissertation on the revolutions that have taken place in the terrestrial globe, and the strata which compose it. Part of this appeared in the memoirs of the academy, and the *Journal de Physique* of 1772.

The memoirs of the year 1778 contain many inquiries relative to the nature of water, and the experiments in consequence of which the possibility of converting it into earth had been inferred. Lavoisier demonstrated that the earth found, while distilling water, was nothing more than a part of the vessel decomposed during the process; on this occasion he continued the experiment for 101 days. At the end of that period the result was, that the total weight of the vase and the water remained the same, but on examining the particulars, it was discovered that the alembic had diminished, and the augmented in exactly the same proportion.

demonstrated, in 1774, that the augmentations of metallic calces (*chaux metalliques*) arose from air confined in the vessel; and this question long agitated by naturalists, was at length settled by means of experiments, which were at length performed with sagacity: this

served as the foundation of the new chemical theory, and it was by these means that he began to attack the doctrine of phlogiston, to which, until then, every thing had been referred.

In 1783 he was enabled to prove that the purest air, the air eminently calculated for respiration, the dephlogisticated air of Priestley, was the constituting principle of acidity, and that it is common to all acids. He gave the appellation of oxygen to that portion of vital air, which enters into the composition of all acids that unite with metals, reduces them to the state of a calx, and produces vital air when it combines with the principle of heat. This was the second marked and decisive step taken by him in the chemical theory of which he is undoubtedly the author.

In the month of June, 1783, Lavoisier, who, in pursuance of the principles founded on a theory already confirmed by so many experiments, had prepared an apparatus on purpose to communicate a high degree of ignition in close vessels to inflammable and vital air, discovered that there resulted from this combustion a liquid, which proved to be water in an extremely pure state, the weight of which was exactly equal to that of the two airs employed. Having learned that Cavendish and Monge had already effected the same result, he formed another apparatus for the decomposition of water, separating the inflammable from the vital air, by means of pipes composed of *iron made red hot*; and it is this

mode which has been adopted, during the present war, to fill the balloons, globes, or montgolfiers, in order to observe the motions of the enemy's armies.

Turgot, in 1776, was desirous of employing him to superintend the manufacture of gunpowder, that he might be thus enabled to contribute to its perfection; and it soon attained such a degree of superiority, that the same charge was enabled to reach a distance of 120 toises, which, before his time, only carried 90. The consequence was, that whereas the English shot, during the war of 1756, reached us (says Leland) before we could touch them, and in that of 1778, they complained that they were assailed by our balls, before theirs could do us any damage.

Some new experiments had nearly cost him his life, in consequence of a terrible explosion that took place at Etone, by which many persons lost their lives. These enabled him to make a complete analysis of the nitrous acid; an acid so easily destroyed, so difficult in its formation, but which, however, is of the utmost importance, since it constitutes one of the elements of saltpetre and gunpowder.

I shall not undertake to follow Lavoisier in the detail of the researches made by him relative to the different metallic oxydes, and the quantity of oxygen contained in them; the formation of acids by the humid mode; the affinities of oxygen; the passage of this principle from one substance to another; the cold combustions, and the inverse operations of
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the combustion; the salubrity of the air, and the circumstances that alter its respirability; the means of correcting, re-establishing, ameliorating it, &c. these having been given in a former part of this volume. Such were the immense objects of his inquiries relative to the most important branches of the new chemistry.

In 1789 Lavoisier attempted to arrange the results of his experiments in a methodical order, and thence to form his work, entitled, "*Des Elémens de Chemie*," (*Elements of Chemistry*). Two editions of this publication were already sold, and he was preparing a third, much more extensive than the former, which gives an entire new form to the science.

It is impossible to determine what has, or what might have been the influence of the labours of Lavoisier in manufactures, &c. But one may judge from this circumstance, that chemistry has entirely changed the process of dying; nearly all the phenomena, at present presented by this art, are now reduced to the principles of combustion and decomposition; more especially since the important work of citizen Bertholet, "*Sur la Teinture*," (*On Dying*). This, which was formerly, in a great measure, empirical, is now conducted by means of a theory equally simple and luminous.

The process of extracting metals from their mines, of melting and manufacturing them, of converting iron into steel, of bleaching linen, wax, &c. in short, nearly

nearly all the chemical arts, have approached rapidly towards perfection under the guidance of the new chemistry.

By applying these discoveries to the phenomena of respiration, Lavoisier has shewn that this vital function is a real combustion of *carbon* and *hydrogen*, and that it proceeds from the formation of carbonic acid and water. *Animal heat* is the result of this combustion, and he was, at length, enabled to determine the quantity of it. In short, the experiments before alluded to conducted him to the intimate connexion subsisting between the acceleration of respiration, and that of circulation and transpiration, and also between their different forces, and the employment of these forces by the animal; we also know, that he had long meditated an extensive work on digestion.

The last, and perhaps the most important labours of Lavoisier, were directed to the transpiration of animals; the papers on this subject were read by him, before the academy, on the 4th of May 1791. Lavoisier begins by observing, that the animal machine is kept together by respiration, transpiration, and digestion. He enters into a chemical analysis of the effect of each, and the nature of cutaneous and pulmonary transpiration. He then separates these from their effects, and interrogates nature, as it were, relative to the three causes which produce them.

He had conceived the idea of a machine, in which
all

all that appertained to transpiration passed outwards, and all belonging to respiration inwards; and, in conjunction with citizen Seguin, he accordingly undertook some very difficult and laborious experiments, by which he discovered, that the loss of weight in a man, in consequence of transpiration, amounts to 2 lb. 13 oz. that he consumes 33 ounces of VITAL AIR in 24 hours; that he disengages from his lungs 8 cubical feet of CARBONIC ACID GAS, of which one-third consists of *carbon*, and two-thirds of *oxygen*; that the weight of WATER, which evolves itself in the lungs, amounts to 1 lb. 7 oz. of which 2 ounces are *hydrogen*, and 3 *oxygen*; and that 6 ounces of WATER, entirely formed by pulmonary transpiration, is disengaged in the same space of time.

He had constructed balances, by means of which a demi gros, added to 125 lb. was perceptible; and instruments the most precious, and expensive, were eagerly supplied by his zeal.

In consequence of these curious and difficult experiments, he had already acquired much information relative to the causes of different maladies, and the means of seconding the efforts of nature in their cure; nay, he was preparing to attack the ancient and *revered Colossus of medical errors*. Nothing could have been more important than this undertaking; and it may be fairly said, that if the sciences have suffered an irreparable loss, *humanity* also ought to bemoan the death of Lavoisier.

The

The reputation acquired by the labours we have just mentioned, caused him to be selected by the academy of sciences, in execution of the decree of the 27th of September, 1791, as one of the members of the bureau de consultation, (committee of consultation). He assisted at their sittings with his usual assiduity; he contributed greatly to enlighten the members on the merits of the discoveries laid before them, and in the claims of the various artists, which they were to recompence. He was also entrusted with other important functions, viz. that of superintending the experiments and inquiries decreed by the national convention, in order to contribute to the means of perfecting *assignats*, and also that of rendering the forgery of them more difficult.

Political arithmetic, or, in other words, the details of population, consumption, productions, and agriculture, occupied much of the attention of this excellent citizen. Between 1773 and 1785, he himself caused two hundred and forty French acres (*mesure des eaux et forêts*) to be cultivated under his own immediate direction in the *Vendemois*, on purpose to exhibit useful examples to the inhabitants of the country. He produced three septiers * on the same quantity of land that had before yielded but two. And at the end of nine years he had doubled the produce.

* A septier is about twelve bushels English measure.

In 1791 he was nominated a commissioner of the national treasury: this was a loss to the sciences; but no person was better adapted than himself to fulfil the difficult and important functions of his new office, on account of his extensive knowledge. Without ceasing to pursue his former studies, he established such order and regularity in the public accounts, that the receipts and expenditure of all the national offices during the day, might have been known in the course of the same evening.

The grand and important labour relative to the new *measures* about to be established throughout the republic had occupied the academy ever since 1790; but no one had taken more pains, or been so useful on this occasion, as Lavoisier.

The dilatation of metals by heat was an important subject not sufficiently attended to. He therefore caused an *apparatus* to be constructed in the garden of the arsenal, by means of which metal rules plunged into water, and subjected to different degrees of heat, gave motion to a glass, that marked on a distant object the different degrees of dilatation; and when, in 1793, it was intended to measure a base for a new meridian, with a precision until then unknown, he placed graduated rules of platina and brass in his own garden: these formed so many metallic thermometers, by means of which the immediate effect of each degree of heat was instantly discernible, without having recourse to a separate thermometer.

Lavoisier

Lavoisier succeeded Buffon and Tillet as treasurer of the academy, and he was not only serviceable to it, but also to the academicians, by his activity and credit. He introduced new regulations into the accounts, and also into the inventory of the cabinets; and he converted the unemployed funds possessed by the academy, to the advantage of the sciences. In short, Lavoisier was present every where; he was the man whose countenance was deemed necessary on all occasions, and he was adapted to every thing, on account of his activity and his zeal, which were alike admirable.

A man so rare and so extraordinary ought to have enjoyed the respect of the most ignorant, and even the most wicked. To produce the contrary, it was necessary that power should fall into the hands of a ferocious monster, who did not respect any one, and whose blind and sanguinary ambition sacrificed every thing to the desire of pleasing the people. It was supposed, that the immolation of the farmers-general would give them satisfaction. Pretexts were accordingly fought for in order to cut them off. It was on the 19th *Floreal* (8th May, 1794) that twenty-eight farmers-general were assassinated by a mock tribunal of executioners, whose decisions had nothing of justice in them but the name.

For his own justification, and that of his colleagues, Lavoisier had drawn up such a satisfactory memorial, that it was impossible to foresee that crime itself could go beyond the invasion of their

fortune. Lavoisier observed a few days before his death, that he foresaw they would despoil him of all his property, but that he would earn a livelihood by his labours; and it appeared to me, that the station of an apothecary was that which he would have preferred, as being most analogous to his attainments and reputation.

At the moment they were occupied about this pretended judgment, a paper drawn up by citizen Hall, of the office of consultation, was pretended to the tribunal, and in this there was a description of the works, and a recapitulation of the merits, of Lavoisier, capable of making an impression on the most hardened of mortals; but it could make no impression upon these blind, stupid, and ferocious instruments of cruelty and murder; accordingly there perished on the scaffold the greatest man that France ever saw.

In 1771 he espoused Marie-Anne-Pierrette Paulze, daughter of a farmer-general, whose good nature and accomplishments formed the delight of his life, who seconded him in his labours, and who even engraved the figures in his work. This woman, so worthy of exciting interest, beheld her father, her husband, and most intimate friends, all assassinated in the course of the same day. Imprisoned herself, and even menaced with a similar fate, her courage rose superior to all the horrors of her situation; she escaped these inhuman butchers, but she was only deserving of more pity on this very
account,

account, because she was calculated by nature to receive a deeper impression from the atrocity of the crimes with which she was assailed and felt the stab.

Lavoisier was tall, and possessed a benignant countenance, which bespoke genius. His character was mild, humane, sociable, obliging, and he evinced an incredible degree of activity. His credit, his fortune, his reputation, and his office in the treasury, gave him great preponderance, but the only use he made of it was to do the greatest good; but this, however, did not prevent his meeting his end from the hand of the executioner, which he bore with all the fortitude imaginable.

S E C T. XXI.

OF OXYGEN AIR AS A MEDICINE

JOHN HUNTER, as we have just seen, by the acuteness of his genius, had hit upon the *true doctrines* of PHYSIOLOGY; nevertheless it is but justice to the modern pneumatic philosophers to remark, that the extracts that have been given from his works are like a rich vein of gold depurated from much dross, or opinions, which shew how short the human reason may fall, when trying to penetrate into subjects without the proper data; for, unfortunately for science, John Hunter was, to use the vulgar phrase, no chemist, or, in other words, he was a very bad one; hence his opinions, although he lived in the time of Dr. Priestley, and after his discovery of vital air, are often contradictory. He, however, still possesses the greatest merit, and his section on the life of the blood will redound eternally to his honour.

After physiology had received all the advantage that could be derived from the greatest proficiency in anatomy, and the efforts of a great but uninstructed mind *, chemistry lent her aid,

* John Hunter used often to say, he never read, in order that all his works might have the merit, and they certainly have the air, of originality.

and we arrive now at the most brilliant æra in medicine.

The first opportunity I had, says Fourcroy, of paying attention to the energetic action of oxygen belongs to one of those extraordinary circumstances in sensation which is experienced when one is exposed, for the first time, to the sudden operation of certain chemical preparations which are acrid, and as yet unknown. It was in the year 1787, in preparing a quantity of oxygenated muriatic acid for my lectures, two of my pupils, who were occupied in my laboratory in making this preparation, having received a great quantity of this oxygenated muriatic acid gas in the throat and trachea, were immediately seized with a violent and suffocating cough. After many convulsive efforts of the diaphragm, they expectorated a matter as thick as the white of an egg half boiled, and which was of a yellowish white colour, with a greenish tint. This expectoration continued in great quantity until the chest was unloaded, which did not happen until after they had suffered some hours of uneasiness. They complained at first of an extraordinary dryness and tightness in the throat and nose. The *velum pendulum palati* felt to them as if it had become solid, ligneous, and very difficult of being moved; their nostrils felt as if lined with a dry and stiff parchment, and the mucus which was secreted was exceedingly thick; the eyes were red and watery, and the whole face glowed with heat. Some hours

afterwards the eyelids were glued together, and the tears became thick.

In order to ascertain with accuracy the effects of this gas, I impregnated some animal fluids with it, such as the white of an egg, the serum of the blood, and saliva; all of which, I observed, became thick and coagulated by this gas, in the same manner as they do by means of the liquid oxygenated muriatic acid. In proportion as this coagulation took place, the acid gradually lost its character of oxygenation, passed into the state of simple muriatic acid, and every thing proved that the oxygen was taken from it by the animal substance.

To this first and positive information concerning the thickening or coagulation of our fluids by means of oxygen I added several other facts in the years 1789 and 1790, during which time I gave, continues Fourcroy, a very long course of sixty lectures, at the Lyceum, on animal matter. It was, in fact, during these researches that I conceived, and began to execute, the plan of investigations which I have since sent to learned societies. It was then that the immediate thickening and true coagulation of the white of an egg, and the serum of the blood, by means of the red oxyd of mercury, while that metal was almost reduced to its metallic state by the operation, was discovered. This effect was to me a ray of light; it explained to me how the thickness and soapy quality of animal fluids were owing to the tendency which they had to absorb air and be unit-

ed with oxygen; how eggs which had been immersed for a long time in air were sooner hardened than others; and how, in general, all animal fluids were bleached and grew thick on being exposed to the air.

Soon afterwards the examination which Vauquelin and I made of the tears and nasal mucus, enlarged my views of the power and action of the oxygen of atmospherical air on the fluids of animals, which, by their situation and laws of excretion, were exposed to the contact of air. The lachrymal fluid exhibited to us, under similar circumstances to that in which it is placed by nature, a viscosity, which increases from that which is a little ropy to that which forms the white or yellow concretions which cement the eyelids, or which envelope the *carunculæ lachrymales*, after having moistened their surface. After this fluid has descended into the cavities of the nose, and has been united to the mucus there, which it appears destined to dilute, and to detach from Schneider's membrane, I have seen it, in its mixture with this mucus, exhibit a more rapid progress towards concretion and the formation of an opaque solid substance, of the consistency of a jelly or of glue, owing to the constant absorption of atmospherical oxygen. The animal matter which undergoes this change during its oxygenation has an attraction for this principle, which is equal to that portion of animal fluid which is impregnated with soda, which it exercises at the same time upon the

quantity of carbonic acid which is mixed with the air that issues from the lungs. Hence this last is always found in the state of carbonate of soda, in the fluid of the nose; while, on the other hand, it is in a caustic or pure state in our tears. The oxygenation of animal mucus is a little doubtful in this case as the saturation of soda which accompanies it. It can only take place by means of the contact of air. During sleep the tears flow like a fine fluid along the margin of the eyelids, while, on the other hand, during our waking hours they acquire a slight consistency, which causes them to be spread like a transparent membrane on the cornea and sclerotic coats of the eye.

The example of saliva, and the facts relating to it, are neither less striking nor less favourable to my ideas, nor less useful, in order that their immediate application to physiology may be known. It is another liquid on which oxygen has the greatest influence, and which appears destined to be impregnated with it, in order to transport it to the alimentary canal: all the sources from which this fluid flows being open in that cavity which forms a communication between the air and the lungs, and which constantly compresses and mixes this fluid with the others which moisten the inside of the mouth; and, besides this, being disposed, by its mucous nature, to retain between its particles those of the air, it becomes charged with these in every possible degree; and hence the fact announced some years ago by
 Citizen

Citizen Michel Dutennetas, relatively to the oxydation of gold and silver triturated in a glass mortar with saliva, as well as the custom which takes place in some laboratories, of hastening the oxygenation of quicksilver in hog's lard, by spitting from time to time in the vessel in which this tedious process is carried on. I am also persuaded that in the process recommended by Chiarenti of Pisa, for introducing medicines into the system by means of the cutaneous absorbents, the saliva not only serves as a vehicle, but has also a considerable influence on their medicinal properties, in consequence of the oxygen which it yields to the combination that is formed.

From these combinations, which arise from the absorption of oxygen by animal fluids, of oxygen which quits several compound substances to unite with these fluids; from the effect of the thickening or coagulation which takes place in these liquors from their intimate union with oxygen, it appears natural to apply the principle to a medical phenomenon, entered in the register of the school of Cos, and confirmed by the observations of all ages, and of every man acquainted with the art. I allude to what is called *concoction* in diseases, a constant change which announces and accompanies their happy termination. This concoction consists in an equal and homogeneous thickening of some fluid; an effect which it is impossible not to acknowledge as resulting from the *fixation* of oxygen, and which is similar to all the combinations I have already enumerated.

The formation of *pus* belongs to the same class, and obeys the same laws.

Every thing then conspires to shew that, from the facts which I have collected, one of the principal means by which the oxygen of medicines acts, depends on its combination with animal matters, and on the thickening which it produces in the fluids, either immediately and in proportion as it combines with them, or mediately by the disposition to coagulate, which it communicates to them while it only slightly adheres to them. It is, doubtless, from this source that we are to refer the concrescibility and plastic property which is observable in the fluids of those animals which, breathing by means of pulmonary organs more or less extensive, appear to have a thousand mouths open, in order to absorb atmospherical oxygen. It is also this effect to which we must attribute the sudden change that occurs in the ferous humours of atonic ulcers upon the application of oxygenated matters, which change is generally followed by a diminution and thickening of the discharge. This first effect is for the most part immediately followed by cicatrization, as appears in the natural progress of ulcers, which, at the period when they are about to heal, are covered with a thick gluey pus, instead of the ichor which was observable until then. It would be difficult to conceive this absorption and combination of oxygen without observing, at the same time, the source of a change in the nature of the animal substances in
which

which it is fixed, and without admitting that the proportion of their constituent principles suffers a greater or less remarkable variation, similar to that which is always manifested in those chemical experiments in which such substances are acted on by matters which are powerfully oxygenated. This variation, which doubtless is not quite so great in these medicinal effects as in chemical experiments, is, however, similar in its nature, and consists particularly in the separation of a portion of hydrogen which is disengaged or combines with water, as well as in the development of a certain proportion of carbon which is also extricated.

But these chemical actions of oxygen, which assist in explaining its medical effects, are not the only ones which it appears to exert on the animal body; for this, not being solely exposed to chemical agency, must experience medicinal power from other changes. Those things which are commonly denominated organic forces or powers, because they are inherent in living organs; muscular mobility, which, by its obedience to different stimuli, supports motion and presides over life, certainly receives a modification from medicinal oxygen. It is now upwards of twenty-five years since Carminati remarked, for the first time, that animals, suffocated by what was then called fixed air, and which were immediately opened after death, had their hearts so paralyzed and insensible as not to be irritated by the strongest stimuli. It was concluded, at that time, that

that fixed air acted like a narcotic poison, and it has required near twenty years labour and research, before Godwin and Humbolt discovered that the heart lost its irritability and contractility, because the blood which touched it was not endowed with the stimulating power, and that the presence of oxygen in the air could support it. Besides, it has been proved that oxygen gas, breathed pure, augments the heat and vital energy, and that the arterial pulsations and muscular contractions become more violent by doing so. Citizen Van Mons has experienced on himself that the suroxygenated muriate of potash produced an exciting and stimulating effect on all his system to such a degree, that the skin became redder and more animated, his pulse more frequent, and his mind more active. These different effects are certainly very remarkable in the administration of remedies, of which the oxygen is separated in our body, and of which it is probable that oxygen is the only primitive agent, as I have elsewhere endeavoured to prove *.

It was impossible, in this enlightened age, that the nature of the atmosphere should have been discovered, and its separation into two airs, without these discoveries leading to views beyond physiology, and we are conducted, as the reader will find, into a new æra of medicine.

* Vide Vol. V. Sect. XXXVIII. on the medicinal power of oxygen.

The different factitious airs were put to the test at the Hotel Dieu in Paris, many of which proved successful, but some turning out inauspicious *, and the revolution succeeding, with the tyranny of Robespierre, who put to death Lavoisier, and many other literary characters, a veil was drawn over this new branch of science for a time, but as Fourcroy justly observes, “ the analogy of
 “ action which has been discovered between diges-
 “ tion, respiration, circulation, and insensible per-
 “ spiration, has begun to establish on new views,
 “ more solid than were heretofore possessed, a sys-
 “ tem of *animal physics*, which promise an abundant
 “ harvest of discoveries and improvements. Un-
 “ questionably it will be, in pursuing the chemical
 “ changes that are undergone in the system, that an
 “ edifice equally novel and solid will be erected.
 “ Every thing is ready for this ground-work ; sever-
 “ ral philosophers pursue this unbeaten path of ex-
 “ perience ; fresh ardour, springing from these new
 “ conceptions, animates those who are engaged in

* It is remarkable, that the first trial of the vital air was made in consumption in France ; it gave temporary benefit, and spread, as Chaptal says, “ Flowers over the borders of the tomb,” but hastening on the mournful event it was soon abandoned, and had not the ingenious Dr. Beddoes, with his coadjutors, Dr. Darwin, Dr. Ewart, Dr. Thornton, &c. been conducted by a rational theory, which they have confirmed by practice, the aerial remedies had probably met with the same fate as transfusion.

“ this

“ this branch of physics ; and the track they have
 “ just begun to explore appears such as must lead
 “ them to more precious and accurate results, than
 “ any that have hitherto been advanced on the
 “ functions which constitute animal life.”

Whilst the progress of the pneumatic practice of physic was in some measure stopped in France by the revolution, Dr. Beddoes, the celebrated professor of chemistry at Oxford, endeavoured to turn the attention of the faculty in England to this new branch of science. His works soon passed into the hands of every one : for he possessed the rare art of diffusing through his writings that lively interest, that enchanting colouring, and that delicate and vigorous touch, which influence, attach, and subdue the mind. The profundity of his reasoning is everywhere united to all that agreeable imagery, which the most brilliant imagination can furnish. The sacred fire of genius animates all his productions ; his theories constantly exhibit the most sublime prospects in their totality, and the most perfect correspondence in their parts ; and even whilst he raises *hypotheses*, we are inclined to persuade ourselves that they are established truths.

The highest commendation is certainly due to this ingenious philosopher for his chemical investigation of diseases. But the novelty of the attempt soon exposed him to the malignity of some not equally well disposed, and the ardour of pursuit was branded with the name of enthusiasm ; but a virtuous

tuous mind, intent on a generous action, looks upon these as so many steps to distinction; for to be either very good or very great, is to be very much envied, and very much misrepresented. Even some who differ with this gentleman in political sentiments sided with the envious and interested against the *pneumatic remedies*: as monks formerly denied the Newtonian philosophy, only because Newton was a protestant. It is a great misfortune, says Dr. Priestley, “when philosophers forsake their pursuits of “nature, which are ever regular and uniform, to “engage in the confusion of political contests.”—And who is there but must not regret the flight from this country of the author of this very remark, which some years ago he made to the illustrious Franklin? And philosophy droops her head, since Lavoisier was guillotined. He requested but three days to finish an important experiment he had begun, and the stern tyrant * replied, “France “has no need of philosophers, but of patriots;” and ordered him instantly to execution.—But Dr. Beddoes may perhaps reply, “Homo sum, et hu- “mani nihil a me alienum puto,”—to which I confess I should be at a loss what to answer!—His theories

* Robespierre.

† Dr. Beddoes has published an attack on Mr. Pitt, an account of the gagging bill, &c. Even the author of this work, burning with zeal to serve mankind, laid aside for a few months medical enquiries, and formed his *POLITICAL EXTRACTS* in three volumes octavo, published by the book-sellers

theories of diseases * will no doubt one day or other conspire, with future discoveries in chemistry, to unravel the whole of their mysterious operations: and ingenious physicians, having learnt to manage their intricate and multifarious machinery, may see that art, which can rest firmly upon no other foundation than a just theory of the functions of the body, rising under their hands into a beautiful and solid *structure*. “Nor,” says Dr. Beddoes, “how-
 “ever remote medicine may at present be from
 “such perfection, do I see any reason to doubt
 “that, by taking advantage of various and conti-
 “nual accessions as they accrue to science, the same
 “power will be acquired over living, as it is at pre-
 “sent exercised over inanimate bodies; and that
 “not only the cure and prevention of diseases, but
 “the art of protracting the fairest season of life, and
 “rendering health more vigorous, will one day half
 “realize the dream of alchemy.”

The celebrated Dr. Darwin, who has of late turned his attention much to this subject, observes,
 “that *vital air* penetrates the fine moist membranes
 “of the air-vessels of the lungs, and unites with the
 “blood by chemical attraction, as is seen to hap-
 “pen, when blood is drawn into a basin, for the

sellers named in the title page of this work. He has however finally relinquished *politics* for the contemplation of medicine and of nature.

* Vide Observations on the Nature and Cure of Calculus, Sea Scurvy, Putrid Fever, &c.

“Tower

“ lower surface of the crassimentum is of a dark red
 “ so long as it is covered from the air by the upper
 “ surface, but becomes florid in a short time on its
 “ being exposed to the atmosphere. The perpe-
 “ tual necessity of the mixture of *vital air* with the
 “ blood in the lungs, evinces that it must act as a
 “ stimulus to the sanguiferous system, as the mo-
 “ tions of the heart and arteries presently cease,
 “ where animals are immersed in air which possesses
 “ no oxygen.—It may also subsequently answer an-
 “ other important purpose, as it probably affords
 “ the *material* for the production of the *sensorial*
 “ *power*; which is supposed to be secreted in the
 “ brain and medullary part of the nerves; and that
 “ the perpetual demand of this fluid in respiration
 “ is occasioned by the *sensorial power*, which is sup-
 “ posed to be produced from it, being too subtle to
 “ be confined in any part of the system *.”

The late celebrated Dr. Withering of Birming-
 ham, in a letter to Dr. Duncan, has the following
 observations with respect to pneumatic medicine.
 “ With us, pneumatic medicine is advancing;
 “ hydrocarbonate and oxygen are the two airs
 “ that have mostly been used; and these should be
 “ diluted with eighteen or twenty times their bulk
 “ of atmospheric air. The former weakens the
 “ stroke of the pulse, occasions vertigo, and some-

* Vide *Zoonomia*, or the Laws of Organic Life, Vol II.
 A work which occupied, as this philosopher says, thirty years
 deep meditation.

“ times excites nausea. It produces a disposition
 “ to sleep, abates the cough, and eases the respira-
 “ tion in some asthmatic affections ; but in active
 “ hemoptoe, it effects a cure more speedily, and
 “ more pleasantly, than I have seen done by any
 “ other means. Oxygen, on the contrary, excites
 “ the action of the arterial system, warms the ex-
 “ tremities, and seems to invigorate the vital prin-
 “ ciple without exhausting it. From these last
 “ circumstances, you will at once conceive it ap-
 “ plicable to a very extensive class of diseases. I
 “ have lately used it with advantage in two cases of
 “ melancholy ; and I have seen it remove the pa-
 “ ralysis of lead, which had been treated to little
 “ purpose, by the other more usual means.”

The Rev. Mr. Townsend, the learned author of
 a system of Therapeutics, observes, when speaking
 of the different *factitious airs*, “ that these promise,
 “ under the skilful management of Dr. Beddoes at
 “ the Hot Wells, Bristol, and Dr. Thornton in
 “ London, to be a remedy well worthy the atten-
 “ tion of the medical practitioner. The *vital air*,
 “ properly diluted with common air, is a stimulus
 “ the most natural and diffusive. It promotes the
 “ insensible perspiration, greatly aids digestion, fa-
 “ vours sleep, exhilarates the spirits, and relieves
 “ difficult respiration. It is found of the highest
 “ advantage in most nervous diseases. The *azotic*
 “ *air* abates inflammation, and is the only remedy
 “ with the *hydrogen air*, that is found capable of
 “ arresting

“ arresting the progress of consumption, and the
 “ *carbonic acid air* is a most powerful antileptic.”

It being ascertained by direct experiment, that the heart and arteries can be *raised* from 64 to 120 pulsations in a minute, by the inhalation of pure *oxygen*, or *vital air*, and that by abstracting this *vital gas*, from atmospheric air, their actions can be *lessened* from 120 to 64 beats in a minute, the *pneumatochemical* physician has therefore a complete power over the heart and arteries, just as a watch-maker has a power over the movement of a watch by means of the regulator. It being likewise proved, that the blood and solids are composed in part of *vital air*, he has also the power of altering the mass of blood, and therefore of changing the constitution. He possesses in the *vital air* a means of unlocking obstructed vessels, promoting the insensible perspiration, quickening the digestion, increasing the animal heat and muscular powers, and of raising the spirits. He can render the respiration easy, and give bloom to the complexion*.

To conclude.—The *pneumatic doctrine of physic* has met with a welcome reception, not only among the learned of our own country, but in foreign parts. Dr. Rush has endeavoured to apply it to the explanation of some appearances exhibited in the late destructive fever at Philadelphia. In other

* These positions have been proved in the different sections of this volume, and may be found in Dr. Beddoes' considerations, having been confirmed by Dr. Thornton and others in their letters to Dr. Beddoes, passim.

parts of America physicians of the greatest celebrity have spoken in favourable terms of this investigation. Dr. Garnet, who is gone from this country, with an appointment of Glasgow professor of experimental and natural philosophy, is deeply engaged in unfolding the nature of eruptive diseases upon the new doctrines. In India this investigation has proceeded with rapidity, and has been ably applied by Dr. Briggs in illustrating the cause of hepatic affections. At Vienna, where the subject was early introduced by a letter from Dr. Ingenhouz to Dr. Scherer, it has been warmly taken up. Spain, which can boast of medical men of the most enlarged views, has adopted measures still more decisive. The English tracts, in which the use of airs in medicine is recommended, have, I am informed, been translated by order of government; and what is more to the purpose, I certainly know that a small *pneumatic hospital* has been established at Madrid. In Prussia it has been pursued by Dr. Acard. A pneumatic hospital is erected and established at Bristol under the conduct of the enlightened and philanthropic Dr. Beddoes. In short, the *anti-pneumatists*, if I may so denominate those who are eager to stifle the inquiry, whatever be their local vogue, will principally be found among physicians, or apothecaries, neither liberal in their conceptions, nor conversant in that great branch of natural philosophy, which unfolds the properties of *permanently elastic fluids*.

S E C T. XXII.

OF OXYGEN AS RELATED TO IRRITABILITY.

DR. BEDDOES suspects oxygen to be the principle of irritability, but if philosophers have not gone so far as to shew what the *irritable principle* is, they have discovered, at least, the *condition* of its *existence*.

They observe first, “*that every thing that increases the quantity of oxygen in organized bodies, increases at the same time their irritability.*”

A considerable quantity of very pure *oxygen air* was injected into the jugular vein of a dog. Upon opening the thorax and the pericardium of the animal, the heart was found *more irritable* than ordinary, and its alternate contractions and dilatations continued upwards of an hour.

The *right auricle* of the heart was vermilion, and it contained, as well as the *right ventricle*, a great quantity of blood of a bright vermilion colour. The blood contained in the *left auricle*, in the *left ventricle*, the *aorta*, and the *arteries*, was of a bright rose colour, and mixed with bubbles of air.

All the muscles were *more irritable* than ordinary.

After the blood contained in the heart and arteries was discharged, the *irritability* of the heart and muscles was sensibly diminished.

This experiment proves, most decisively, that the *vermilion* colour which the blood assumes in passing through the lungs is not owing to *the loss* of *charcoal* and *hydrogen*; but that it proceeds from *the combination* of the blood with the *oxygen air*.

In the experiment I have just now described, the livid colour of the venous blood in the *right auricle* and *ventricle* of the heart was changed to that of vermilion. Nevertheless it could not have *lost* any *carbon* or *hydrogen*: it therefore only *acquired oxygen* or *vital gas*.

This experiment is also a direct proof that *oxygen* favours *the principle of irritability*; for by *sur-charging* the blood with *oxygen*, by *hyper-oxygenating* it, if I may use the expression, the *irritability* of the contractile fibre was, as we have seen, considerably *increased*.

The *irritability* also of persons made to breathe *oxygen air* is wonderfully increased, as is shewn by an universal increase of energy in the system. But what shews most clearly, that the *irritability* is always *in proportion* to the quantity of *oxygen* in the system, are the phænomena attending the action of *mercury* and *mercurial oxyds* upon animals. As this is one of the most striking proofs of this theory, and as many persons, and amongst the rest, philosophers of the first rank, such as Dr. Crawford, have been struck with the novelty and simplicity of my mode of explaining these phænomena, I cannot forbear,

forbear, says he, entering into some detail upon this subject.

It is a well known fact among physicians, that *mercury*, in its *metallic state*, has *no effect* upon the human body. I have known many people, who for many years have taken a daily portion of quicksilver, to the amount of one or two ounces, but who never perceived any effect whatever from this singular and ridiculous custom. It is proved also by the experiments of Dr. Saunders, that the effects of mercurial ointment are owing only to the small quantity of mercury that has been *oxydated* during a long trituration. It is necessary, therefore, that mercury should be oxydated, to have any effect on the human body. Besides, it is well known that in persons who have rubbed themselves with mercurial ointment, or who have taken the oxyd of mercury, the *mercury*, after having *produced* its usual effects, has passed through the skin in a *metallic form*, and has amalgamated itself with watches, and the gold in the pocket, &c. The oxyd of mercury, in passing through the human body, parts with its *oxygen*, and it is this *oxygen* alone, which remains combined with the system, that *the effect* produced by *oxydated mercury* is owing. Thus *arsenic*, under its metallic form, has no effect upon animals; but the *white oxyd* of this metal is one of the most terrible poisons; for it *hyper-oxygenates* the organized fibre with which it comes into contact, and reassumes its metallic form.

The cause of the beneficial effects of *steel* on the animal œconomy has not been hitherto sufficiently scrutinized. According to Mons. Chaptal, the red particles of blood almost wholly consist of *iron*. And it is well known that the blood acquires its florid colour from its exposure to the air in the vesicles of the lungs, from whence nothing but *vital air* is absorbed. It seems therefore probable, that the red particles of blood consist chiefly of particles of iron, calcined by the *oxygen*, or *vital air*, and reduced to the state of a red oxyd of iron. Hence it appears, that *chalybeates* will not only increase the quantity of red particles in the blood on which the stimulant and tonic powers of that fluid most probably in a great measure depend, but will enable it to decompose a larger quantity of air which is received in the lungs by respiration, and thus occasion a greater evolution of heat, and will produce the same effect upon the system, as if a much purer atmosphere had been breathed for some time *.

By various experiments of Dr. Hale's, compared with those of Dr. Ingenhouz, it is evident, says the celebrated author of a system of Therapeutics, that vegetables in summer, while they enjoy the sun, are incessantly decomposing water, and emitting from their leaves their *oxygen* combined with *caloric* in the form of *vital air*. And it is clear, that as long as

* This consideration is taken up more at large in Vol. V. Sect. XXXVIII. and XXXIX. on the medical power of oxygen.

water is supplied abundantly, they not only preserve their vigour, even at mid-day with the most fervent heat, as in the south of Spain, but make a rapid progress in their growth, and emit a proportionable quantity of *vital air*. May we not infer from thence, *that their irritability depends on oxygen, and their vital energy on a plentiful supply of this reviving element*, whilst the *hydrogen* of the water not only supplies the combustible part of vegetables, but, by depositing its caloric, maintains the vital heat.

Were these facts well ascertained, it would throw great light upon the operation of these medicines in the human frame, and contribute to establish the system, now received by many, respecting *irritability* as induced by *oxygen*.

2. “*Whatever diminishes the quantity of oxygen in organized bodies, diminishes at the same time their irritability.*”

A small quantity of *azotic air* was injected into the jugular vein of a dog. The animal died in twenty seconds. Upon opening the thorax, the pericardium, and the heart,—*the right auricle and ventricle were* filled with black blood. The *left ventricle* was of its ordinary colour. The heart, and almost all the muscles, had *lost* their *irritability* almost entirely; they contracted but weakly upon the application of the strongest stimuli, such as sulphuric æther, and the electric spark.

When consumptive patients breathe *azotic* or *hydrogen air*, blended with a small portion of *common*

air, the circulation, irritability, sensibility, and appetite, is diminished, and the hectic fever is abated*.

There was long since a dispute between Dr. Whytt and Baron de Haller respecting *irritability*, and that dispute is not yet completely settled. The *former* attributed this power wholly to the *nerves*; the *latter* to the *muscular fibre*, independent of the nerves.

But were we permitted to reason from analogy, we might suspect, if not conclude, that since *plants*, by irritability alone, without brain or nerves, exercise the vital functions; these likewise may in animals depend on the irritability of the muscular fibre, whilst sensation, thought, and voluntary motion, result undoubtedly from the presence of a brain.

The womb, in the time of pregnancy, increases in substance and size probably fifty times beyond what it naturally is, and this increase is made up of living animal matter, which is capable of action within itself. I think we may suppose its action more than double; for the action of every individual part of this viscus, at this period, is much increased, even beyond its increase of size; and yet we find that *the nerves of this part are not in the smallest degree increased*. This shews that the nerves and brain have very little to do with the actions of a part:

* Vide Observations on the Medicinal Use of the Facitious Airs, by Dr. Beddoes; also the Letters of Dr. Thornton, Dr. Ewart, Dr. Peart, &c. to the same.

while the vessels, whose uses are evident, increase in proportion to the increased size: if the same had taken place with the nerves, we should have reasoned from analogy!

If nerves, either of themselves, or from their connexion with the brain, gave vitality to our solids, how should a solid continue irritable, after a nerve is destroyed, or paralytic? for the part continues to be nourished, although not to the full health of voluntary action; and this nourishment is the *blood*, for deprive it of the blood, and it mortifies.

This opinion is countenanced by the experiments of Baron de Haller; some of which are recorded in one of the early volumes of the Philosophical Transactions, for it appears that a *paralysis* of the posterior extremities of animals was induced by tying their aorta.

The learned Dr. Monro, who was not much inclined to give up the pre-eminence of the brain and nervous system to the vascular, after many experiments was obliged to conclude, “*that concomitant arteries, somehow or other, tune the nerves, so as to fit them to convey impressions.*”

In order to decide, says the ingenious Dr. Fowler, whether a greater detriment to that condition of a limb, upon which contraction depends, is induced by interrupting its circulation, or by intercepting its communication with the brain, I resolved upon trying the powers of the nervous electricity as discovered by Galvani.

Having

Having tied the crural artery on one side, and divided the sciatic nerve on the other, on three full grown frogs, I cut off their heads with a pair of scissars, to preserve the circulation of the blood as entire as possible, and at the same time to prevent the continuance of pain, which might exhaust the power of the body, and defeat the experiment.

When these frogs were laid upon a surface of zinc, and excited by means of a rod of silver, the contractions were found extremely feeble in the legs whose artery had been tied, and ceased altogether in about twenty-two hours after their death. But in the legs, whose nerve had been divided, they appeared very vigorous, and continued excitable upwards of two days after they had ceased to be so in the other.

Having thus found, that a diminution of the circulation of a part, was accompanied with a proportionable diminution of the respective powers of nerves and muscles in that part, I next proceeded to examine if an increased circulation would be attended with a proportionable increase of these powers; and that this is actually the case, the facts I am about to relate will prove.

I have before shewn, that if a living and entire frog be set upon a plate of zinc, contractions can very seldom be produced in any part of its body by passing a rod of silver over it, so that the silver, the frog, and the zinc, may be all in contact with each other. But I have found, in upwards of twenty
I
experiments,

experiments, that when inflammation had been excited in one of the hind legs of a frog, by irritating it with a brush, contractions uniformly took place in that leg when the metals were applied to it, although none had been produced in it before it was inflamed, nor could still be produced in the other leg which remained in its natural state.

Having previously, continues Dr. Fowler, excited inflammation, by means of a brush, in the foot and leg of a healthy and large frog, I cut off its head. The contractions excited by the different metals in the inflamed leg were in vigorous and instantaneous jerks; those in the sound leg more languid, and difficultly excited. Spontaneous motions continued at this time nearly the same in both. Even till the end of the second day, after the frog's head had been taken off, the contractions excited in the inflamed leg continued uniformly, and beyond all comparison more vigorous than what I could by any means excite in the sound leg. It then became very stiff.

Dr. Fowler, from these experiments, has judiciously concluded, that the *sanguiferous system* contributes more immediately than the *nervous* to the support of *that condition* of muscles and of nerves, on which *depend all the phænomena of contraction in the animal fibre*.

This subject, it must be confessed, is after all exceedingly abstruse, and the ideas of the best physiologists are not so clear and distinct, so complete and comprehensive,

comprehensive, as we could wish : but, as Dr. Beddoes has judiciously observed,

“ We should set a proper value on our present knowledge, although it be imperfect, and restrain those rude hands, that are ever ready to pluck up the tender plants of science, because they do not bear ripe fruit at a season, when they can only be putting forth their blossoms.”

PRACTICAL OBSERVATIONS.

S E C T. XXIII.

OF THE GAZEUS OXYD OF AZOT.

This new tried gas may be considered as a more powerful form of OXYGEN GAS, and hence, between the two, we shall now have at our disposal an infinite series of powers.

Dr. BEDDOES.

AT length, says Dr. Beddoes, after some digressions and much delay *, we have it in our power to announce the first proceedings at an establishment, for applying chemistry to the elucidation of animal nature,

* The plan was first publicly proposed by Dr. Beddoes in the year 1794. In 1795 he writes, " more than three years have elapsed since I laid before the public my reasons for supposing that factitious airs might be advantageously introduced into the practice of medicine. The facts at that time ascertained, or believed to be ascertained, were not sufficiently numerous for conclusive reasoning. But the minds of many friends of humanity were filled by these speculations with the most pleasing hopes; and the liberality of William Reynolds, of Coal-pit Bank, Joseph Reynolds, of Ketley, and William

nature, or for pursuing the connexion between the properties of elastic fluids, and the conditions of life. By such an investigation, the public has been already too often told how much I consider it as practicable to advance *physiology*, the most interesting of the sciences, and *medicine*, the most useful of the arts. Intimately persuaded that immense improvements

William Yonge, of Shesnal, Shropshire, who each advanced an hundred pounds, enabled me to ascertain by experiment the practicability of what I had proposed. The project could not be lost upon an inquisitive age. By the ignorant who hardly want the temptation of interest to viliify what they do not understand, the design is indeed derided or ridiculed. But it has been most effectually supported by able suggestions and accurate observations from various practitioners of medicine. No person ingenuous enough to examine a new method before he pronounces, can now doubt of the safety of this method of treating the sick; and without the entire rejection of human testimony in medicine assent cannot consistently be withheld from its efficacy in removing some diseases, and permanently relieving the most excruciating pains to which human beings are liable.

I presume not, however, to assert that we have data on which we can securely establish general inducences. I shall be content if it be granted that enough has been done to justify further inquiry. The precise extent, to which a *pragmatic* practice may be advantageous, remains to be decided by cautious experience; and who, that has any regard for truth and for mankind, but must wish the most effectual measures to be taken for arriving at such decision?

My own reflections led me to believe that a small appropriated institution would conduce more to this purpose in

provements must, sooner or later, result from the inquiry, provided nature be consistent with herself, and nothing doubting the truth of this, the fundamental postulate in all philosophy, I felt little discouraged by failures, which the presumption of sciologists has often busied itself in representing as decisive. Nor has the intelligent part of the public, I believe, been induced to regard as finished that

two, than occasional and dispersed practice in twenty years. Many persons, eminent for professional or philosophical knowledge and general good sense, declared it as their opinion, that an adequate subscription might speedily be raised, since nothing—not even the prosecution of the war—could be more urgent than to restore health and preserve life. They knew that the kingdom must contain a number of individuals, ready to redeem themselves from boyish disorders, if by any new means relief could be effected, even at an unlimited price. They imagined that every individual would contribute a small sum for the sake of having a remedy in store in case they themselves, or their near relations should be attacked by such disorders. This expectation was perhaps formed without sufficient attention to the actual indifference of mankind to domestic good, if it be at any distance: and it was forgotten that those instances of national munificence which encouraged our hopes, might be more owing to fashion or momentary warmth of feeling, than to deliberate philanthropy. Whatever was the cause, the attempt to procure contributions has met with inconsiderable success. A sum, not much exceeding 800*l.* has been collected, though most of those who can be considered as *my, owners of medicine*, have publicly testified their approbation of the inquiry; and though the list of subscribers, if the sanction of names be regarded, cannot fail to satisfy the most scrupulous examiner."

which

which could not properly be said to be begun. For myself, among a multitude of reports, observing some far more favourable than could be expected from the excessive disproportion between the means hitherto employed, and the end in view, I incessantly persevered in urging the execution of the design. How widely this proceeding departed from that *wary professional conduct*, which, above all things, avoids committing itself by any measure of striking singularity, and is content with the eternal repetition of processes, from which nothing of advantage is expected, and nothing gained, I could not be insensible. The present was, perhaps, the first example, since the origin of civil society, of an extensive scheme of pure medical investigation. The object, above every other that has been proposed in the same department of knowledge, required, to its attainment, the utmost efforts of patient genius. It could not therefore escape me that the pursuit might, in its own nature, be highly rational, and yet that those who first engaged in it, might never strike into the right path. It was plain that we might even prepare a happier æra for mankind, and yet earn from the mass of our contemporaries nothing better than the title of *visionaries* or *enthusiasts*. Still it was in possibility, (indeed, according to my conceptions, in probability) that our endeavours should speedily approve themselves by some discovery, applicable to the relief of the sick. Encouraged by this reflection, I seized every public
and

and private opportunity of advancing the project. But I would not suffer myself to be hurried either by the impatience of some who wished to fix their opinion concerning the medicinal power of gases, or by the reflections of others who (as I am well informed) pronounced with confidence that I should never venture to put them to the proof. Neither did I listen to that well-meaning timidity, which has endeavoured, by maxims ill or well applied, to persuade me that I was too eagerly *forcing* the improvement of medicine. For disease and death would not suspend their operations in compliment to the apathy of the profession, or the public, was clear. And I judged (the event will shew whether I judged rightly), that human reason had attained a degree of strength adequate to the achievement of this most arduous enterprize.

To have engaged in it, however, either without a sufficient fund, or the most able assistance, would have been to do a good cause the most lasting of injuries, supposing (what I have long sincerely believed) that extensive benefit may result from the undertaking. The qualifications of a superintendant were, indeed, of still greater importance than the amount of the subscription. In some hands, the largest sum would have been utterly unproductive. And the acquisition of a properly qualified associate might be considered as more than virtually doubling the fund; since it is the prerogative of superior talents to accomplish great purposes by small means.

A superintendent, equal to my wishes and superior to my hopes, being at length secured, the best method of opening the institution became the next object of consideration. It appeared most prudent to wave the use of gasses for a time, and to confine ourselves to the administration of common remedies. Without conciliating that class from which we were to draw our patients, we could make no progress, and we wished not to exhibit ourselves, as experimenters animated by that spirit of boyish wantonness, which pays no regard to the faculty of feeling in man. The number of invalid paupers, that have resorted to us, shews that we were not mistaken in these views; and while it afforded an opportunity of trying the effects of digitalis, and other substances, which we supposed might possess similar virtue, on a very extensive scale, in consumption, and of verifying, perhaps of essentially improving, the new treatment of syphilis, it constantly offered us the choice of patients, who could have no hope from common remedies, and by consequence might be fit subjects for the factitious airs. Meanwhile, there was a chance that among the possible medical applications of these agents, some one would occur as particularly worthy our minutest attention.

This has actually happened. The species of elastic fluid, which its great discoverer, Dr. Priestley, denominated the *dephlogisticated nitrous air*, and others have since called *gaseous oxyd of azot*, is in general not unknown to chemists, though they are
unacquainted

unacquainted with its composition, its most extraordinary effects, and probably with its perfect preparation. Piqued by the singular contrast of qualities attributed to this air (and also perhaps, in some measure, by the gratuitous and undoubtedly false opinion of my friend Dr. Mitchill of New York, on contagion), Mr. Davy was led cautiously to respire it a few times in small quantity. Still, however, dissatisfied with the result and venturing upon a larger dose, he exhibited a scene the most extraordinary I had ever witnessed, except in the case of that epileptic patient, whom I have described (*Considerations on Airs*, part iv. p. 13) as agitated, in consequence of the respiration of oxygen gas, with a long succession of the most violent movements. The two spectacles differed, indeed, essentially in one respect. In the former every thing was alarming: in the latter, after the first moments of surprise, it was impossible not to recognise the expressions of the most ecstatic pleasure. I find it entirely out of my power to paint the appearances, such as they exhibited themselves to me. I saw and heard shouting, leaping, running, and other gestures, which may be supposed to be exhibited by a person who gives full loose to feelings, excited by a piece of joyful and unlooked for news. As in the case of the epileptic patient, *no weariness or depression followed: so in this case, no exhaustion or languor or uneasy feeling took place.* The experiment Mr. Davy has very frequently repeated, and generally with the highest

pleasurable sensations, and, except under particular circumstances, with considerable muscular exertion, which have not in any instance been succeeded by fatigue or sadness.

Since that time, a number of persons have inhaled the same gas. The following is an abstract of the reports furnished by themselves. The inaccuracies (should any occur) will soon be checked by the full account. Imperfections both accounts will have, for it is impossible for the combined endeavours of the spectator and the subject of experiment adequately to represent what was sometimes seen and felt.

The individuals mentioned below might be classified in various ways. Many had previous apprehension. Some had never heard of the expected effect. Others disbelieved it. A distinction ought also to be made between those who respired before we had learned to prepare the air with certainty, and those who have respired it since. From many hundreds of experiments, we have also now acquired an idea of the dose, suitable to different temperaments. But there was a time, when for want of such knowledge, the results were less agreeable than might have been wished. All these circumstances require attention. At present, however, without attempting any strict arrangement, or analysis, I shall merely endeavour to state the leading circumstances as briefly as perspicuity will allow.

Mr.

Mr. J. W. Tobin (after the first imperfect trials), when the air was pure, experienced sometimes sublime emotions with tranquil gestures, sometimes violent muscular action, with sensations indescribably exquisite; no subsequent debility—no exhaustion.—His trials have been very numerous.

Rev. Rochemont Barbauld felt exhilarated, and was compelled to laugh, not by any ludicrous idea, but by an impulse unconnected with thought, and similar to that which is felt by children full of health and spirits.

Mrs. Barbauld—*the children's friend*. At first, pleasurable sensations, occasioning involuntary laughter; some faintness afterwards.—We now understand the regulation of the dose, so as perhaps to have removed Mr. B.'s languor, and to give Mrs. B. the pleasure without the faintness.

Mr. George Burnet had never heard of the effect of the air—after inhalation broke out into the most rapturous exclamations I ever witnessed—breathed at two o'clock P. M. and had all day a most delightful flow of spirits.

Mrs. Beddoes—very strong pleasurable sensations—inclination for muscular exertion, could walk much better up Clifton Hill—has frequently seemed to be ascending like a balloon, a feeling which Mr. Burnet strongly expressed.

Mr. James Thomson. Involuntary laughter—thrilling in his toes and fingers—exquisite sensations

of pleasure—A pain in the back and knees, occasioned by fatigue the day before, recurred a few minutes afterwards. A similar observation we think we have made on others; and we impute it to the undoubted power of the gas to increase the sensibility, or nervous power, beyond any other agent, and probably in a peculiar manner.

Mr. Thomas Pople—at first unpleasant feelings of tension; afterwards agreeable luxurious languor, with suspension of muscular power—lastly increased powers of body and mind—vivid and highly pleasurable sensations. In a second experiment, all the faculties absorbed in fine pleasing feelings of existence.

Mr. Stephen Hammick, surgeon of the Royal Hospital, Plymouth. In a small dose, yawning and languor.—It should be observed, that the first sensation has often been disagreeable, as giddiness; and a few persons, previously apprehensive, have left off inhaling as soon as they felt this.—Two larger doses produced a glow, unrestrainable tendency to muscular action, high spirits and more vivid ideas.

A bag of common air was first given to Mr. Hammick, and he observed that it produced no effect. The same precaution against the delusions of imagination was of course frequently taken.

Mr. William Clayfield has most resisted the effects of the gas. Pretty strong doses produced a transitory intoxication. In two instances, very large doses have excited the violent muscular orgasm, accompanied

accompanied with exquisite pleasure, and followed by no debility.

Mr. Robert Southey could not distinguish between the first effects, and an apprehension, of which he was unable to divest himself. His first definite sensations were, a fullness, and dizziness in the head, such as to induce fear of falling. This was succeeded by a laugh, which was involuntary, but highly pleasurable, accompanied with a peculiar thrilling in the extremities—a sensation perfectly new and delightful. For many hours after this experiment, he imagined that his taste and smell were more acute, and is certain that he felt unusually strong and cheerful. In a second experiment, he felt pleasure still superior—and has since poetically remarked, that he supposes “the atmosphere of the
“ highest of all possible heavens to be composed
“ of this gas.”

——— Wilmot, M. D. Involuntary laughing, with unusual muscular motions, but no particularly pleasant or unpleasant feeling—heat in the chest—heat and perspiration in the feet. On a second inhalation the sensations were pleasurable.

Robert Kinglake, M. D. Additional freedom and power of respiration, succeeded by an almost delirious, but highly pleasurable sensation in the head, which became universal, with increased tone of the muscles. At last, an intoxicating placidity absorbed for five minutes all voluntary power, and left cheerfulness and alacrity for several hours.

A second stronger dose produced a perfect *trance* for about a minute; then a glow pervaded the system. The permanent effects were, an invigorated feeling of vital power, and improved spirits.

Mr. Notcutt, formerly lecturer on chemistry at Hackney, was twice thrown into an ecstatic pleasurable trance—the first time his spirits were better for the day—after the second, he was languid, but is inclined to impute this to exercise in oppressively hot weather.

Mr. Wedgwood breathed atmospheric air first without knowing it was so. He declared it produced no effect, which confirmed him in his disbelief of the power of the gas. After breathing this some time, he threw the bag from him, kept breathing on laboriously with an open mouth, holding his nose with his left hand without power to take it away, though aware of the ludicrousness of his situation—all his muscles seemed to be thrown into vibratory motion—had a violent inclination to make antic gestures—seemed lighter than the atmosphere, and as if about to mount. Before the experiment, was a good deal fatigued after a very long ride, of which he permanently lost all sense. In a second experiment nearly the same effects, but with less pleasure. In a third, much greater pleasure.

Dr. Beddoes, notwithstanding his apoplectic make, and the first effect of this air was frequently that of producing giddiness, yet from his eager desire of ascertaining the effects of these new powers,

rising superior to self-considerations, he instituted the same experiments on himself as he had done with the oxygen air. His first sensations, says this great and philanthropic character, had nothing unpleasant; the succeeding have been agreeable beyond his conception or belief, even after the rapturous descriptions he had heard, and the eagerness to repeat the inhalation which he had so often witnessed. He seemed to himself, at the time, to be bathed all over with a bucket full of good humour; and a placid feeling pervaded his whole frame. The heat of the chest was much greater from a small dose than he ever felt from the largest quantity of oxygen. A constant fine glow, which affected the stomach, led him one day to take an inconvenient portion of food, and to try the air afterwards. It very soon removed the sense of distention, and, he supposes, expedited digestion. He has never tried to bring on the high orgasm; but has generally felt more alacrity—and he has not experienced one languid, low, *crapulary* feeling.

Upon the whole, Dr. Beddoes believes that the PNEUMATIC INSTITUTION might offer a fair claim to the premium, anciently proposed for the discovery of a new pleasure; and he ventures to say that the first slight unpleasant sensations about the head may be always obviated by due management*.

* Vide “Notice of some Observations made at the Medical Pneumatic Institution.”—In the communication of our full experience, says Dr. Beddoes, neither unnecessary delay, nor
reserve,

reserve, shall take place. We propose to send it abroad along with other matter, in a periodical work, to be entitled "RESEARCHES CONCERNING NATURE AND MAN." After the first number, which we hope will appear in less than three months, the publication will come out quarterly. We trust we shall never be in want of valuable papers; and we think it better to publish at stated times, than to wait for a certain accumulation of materials. We shall insert communications, and perhaps occasionally, translations of important tracts, little known in this country.

A number may sometimes consist of one or two essays only. We cordially disapprove that sacrifice of utility to variety, of which periodical publications so frequently afford examples. Nor would we on any account foment the present baneful taste for desultory reading, which is perhaps the greatest evil that has arisen from the multiplication of the productions of the press.

Dr. Kinglake has promised us his able assistance: and we have other correspondents, upon whose support we can depend. There are few, whose impatience to appear in print our numbers will not succeed each other quickly enough to satisfy. The title of our work shews that we design it for the intelligent out of the profession, as well as in it.

The first number will consist of a "paper on the philosophy of medicine, by the author of this notice—of part of a *new* chemical investigation, connected with the gas so often mentioned, and including its history, by Mr. Davy; of an account of the cases in which it shall have been used; of an account of our experience in phthical cases, by Dr. Kinglake—together with some communications."

S E C T. XXIV.

OF THE ENEMIES TO PNEUMATIC MEDICINE.

GENUS I.

PHYSICIANS MERE COLLECTORS OF FEES, REGARDLESS OF MEDICAL SCIENCE, GIVEN TO ARTIFICE AND INTRIGUE, EACH SPECIES AFTER HIS OWN MANNER.

SPECIES.

1. *The bullying Doctor, D.*

—— Inexorabilis, acer

looks big, struts, swaggers, swears*.

* Surgeons, in our times, more frequently bear these marks. According to a most acute contemporary author, the famous Radcliffe was a complete specimen of the bullying D. “ With small skill in physic, and hardly any learning, he got “ into practice by vile arts.—He would neglect a nobleman “ that gave exorbitant fees ;” and, to heighten the insult by contrast, “ at the same time carefully attend a servant or mean “ person for nothing—he was surly and morose; treated his “ patients like dogs—extended his insolence even to the royal “ family—scorned to consult with his betters on what emergency soever; looked down with contempt on the most “ deserving of his profession, and never would confer with “ any physician who would not pay homage to his superior “ genius, creep to his humour, and never approach him but “ with the slavish obsequiousness of a court flatterer.”

2. *The*

2. The *bacchanalian Doctor*. D. given to fortifness, if not to drunkenness—generally somewhat of the bully.

3. The *solemn Doctor*. D. with garb, voice, gestures, and equipage, contrived to overawe weak imaginations, and hide the futility of his art *.

4. The *club-hunting Doctor*. D. frequenting the crowded haunts of men; pushing himself forward, saluting all he knows, and all who will know him; talking much and loud †.

5. The *burr Doctor*. D. fastening himself upon you as tenaciously as the heads of the noisome weed (*centaurea calcitrapa*), from which the trivial name of the sp. is taken, fix upon your clothes ‡.

* D. of this remarkable species first practised physic with pomp: they invented or borrowed from the other professions those barbarous habiliments, of which ridicule has but lately stripped physicians. In times, when an huge wig, or a flowing gown, could more effectually command respect than sound morality, substantial justice, or useful skill, the stratagem succeeded to admiration.

D. of this species, when a pretext offers, speak ostentatiously of their experience—never suspecting any of their hearers may know that there are understandings which multiplicity of appearances serves but to confound.

† In England, D. of this species have of late been frequently seen in paroxysms of frantic loyalty, and of civisme in France.

‡ Nothing in art, but the juggler's address in making you take what card he pleases out of a pack, equals the dexterity with which D. of his sp. force themselves on patients.

6. The

6. The *wheedling Doctor*. D. with an everlasting smirk upon his countenance—frequent at the polite end of large cities, and at places of fashionable resort.

Var. α. The *Adonis wheedling D.* D. with an handsome face, joined to the wily address, characteristic of the sp.—flourishes at watering places; sometimes joins to his profession the trade of a fortune-hunter; and if he succeeds, “gives physic to the dogs *.”

The Adonis D. has sooner or later a patient of note, ill of a fever or some disease, that usually terminates favourably; in case of recovery the female busy-bodies of the place, exert their spirit of cabal in behalf of the wonder-working youth, and his fortune is made.

7. The *case-coining Doctor*. D. publishing forged or falsified cases †.

8. The

* D. of his sp. when most moderate, prescribe for every rich patient two draughts a day, and one night draught, beside pills and powders.

† A very fertile source of false facts has been opened for some time past. This is, in some young physicians, the vanity of being the authors of observations which are often too hastily made, and sometimes, perhaps, very entirely dressed in the closet. Cullen. Mater. Med. I. 153.

Akin to this flagitious abuse is the practice of purchasing false attestations, on oath, for advertisements; and what is still worse in effect, though not in intention, a custom beginning to prevail among persons of distinction—who cannot
be

8. The *good-fort-of-man* Dr. D. a good sort of man, armed, by some mistake, with a diploma.

Var. . The *gossiping good-fort-of-man* D. fetches and carries scandal *.

9. The *sectarian Doctor*. D. dwelling among his own people at first; and by them often pushed on to spread devastation among the rest of mankind †.

Var. α. The *inspired sect. Doctor*. D. believing himself to be inspired with the knowledge of diseases and remedies.

N. B. Teachers of physic have been considered in civilized countries not much unlike witches. Among rude tribes, as among the Tartar hordes, a kindred variety is universally found. See Gmelin's Travels. But these seem rather to pretend to inspiration, than really to believe that their deity serves them in the capacity of prompter: and they conjoin the characters of priest and conjurer with that of physician. I have not been able to ascertain whether our variety receives the afflatus, except in its medical capacity: and the miracles it has

be supposed capable of discriminating diseases, or deciding on the efficacy of drugs—but who, nevertheless, permit *quacks* to use their names in testimony of cures, which they suppose themselves to have witnessed, or experienced.

* Varieties numerous as the hues of theameleon.

† Varieties manifold; each distinguishable by the livery of its sect—one is too curious to be omitted.

wrought

wrought in this, are not so perfectly authenticated, as to silence cavillers *.

* People are now-a-days delicate in giving recommendations on some occasions; but the best bred persons make no scruple of pressing a favourite physician or apothecary upon their acquaintance. Yet one would think that they are nearly as competent to speak to the merit of a footman, as of a prescriber or compounder of drugs.

Sects sometimes improve this propensity into a regular system of cabal. The deeper the hypocrisy, or the wilder the enthusiasm of the sect. Doctor, the more eagerly will his brother-fanatics dash through thick and thin to serve him.

Now, as belief or disbelief in certain points of theology, has no apparent connexion with skill in the administration of antimony, mercury, opium, and bark, we may deduce from this fact a rule which is probably as little liable to exception, as any that be laid down on the whole subject.

Never call in a physician, because he is recommended by a person of the same sect; the more you are urged, be the more on your guard against the snare. This rule extends to all demoniacs possessed by the corporation-spirit, and to all sets of persons remarkably gregarious.

This genus, species, and their varieties, are taken from Dr. Beddoes' *Jatrologia* in the life of Dr. Brown, when contemplating the causes of the failure of physicians of great ability.

GENUS II.

THE APOTHECARY *, WHO CONSIDERS HIS EMPLOYMENT AS A CHANDLER'S SHOP, AND HAS ALL THE MEAN JEALOUSIES OF TRADE.

* The word apothecary is derived from *αποθηκη*, a shop, these being *originally* mere compounders of medicine. After a time they began like physicians to order, but still charged nothing for advice, and had their advantage only in the drug. Uniting both characters, people were soon constrained to take a vast load of unnecessary drugs, and thus were these men paid for their double office. One of the misfortunes to counterbalance the blessings of riches, says Dr. Beddoes, is that of being unnecessarily obliged to take more medicine than is proper, and the honourable avocation of medicine has justly come into derision and disrepute.—But is there no remedy against this enormous evil, which can put the apothecary upon another and more respectable footing. Why should he not as well charge his *attendances* as the attorney, for health is certainly of as much value as the preservation of riches, and then there would be no occasion to make an *overcharge* for medicine, or to *drench* patients to produce a proper reckoning. If apothecaries must keep shops, the drugs should be fixed by act of parliament, as much as bread, and charged for accordingly. In the present day a pennyworth of rhubarb, or a little tartar emetic mixed with an ounce of pure water, is unblushingly charged *one shilling and sixpence*!—A reformation here is anxiously to be wished, and we trust is at no great distance. The country apothecaries have already begun to charge their visits, and why, I would ask, might not the same be accomplished by the London apothecary?—People then would not so much distrust the means used by the apothecary, nor suspect when the physician was called in (an opinion I know to be *very* well founded), a collusion betwixt the physician and the apothecary to the detriment of the patient.

In a poem published by one of this tribe, speaking of pneumatic medicine, this rhymist laments the injury likely to accrue from it to the physician, the apothecary and druggist, as it could not come into a gallipot, or be put up into ounce phials.*.

THE LAMENTATION.

No more shall Warwick-lane e'er boast of knowledge,

No more physicians argue, in their college,
On topics such as *bisberto* they've chosen,
When principles much diff'rent were supposen.
E'en though they have the skill of Dr. Marriot,
But few shall henceforth ride in *their own* chariot,
But if they come *old* principles to broach,
Shall gladly do it in a hackney-coach.

Woe! to the druggists too, and all who sell
Med'cines to heal the sick, and make them well.
In quest of simples, o'er our fields, they'll roam
No more, but sadly moan their fate at home;
Unless by *bunger* driv'n mad, and *care*,
They *wildly* ramble in the open air;
"In tatter'd weeds, with overwhelming brows,"
Their thoughts,—of *children* and their tender *spouse*:
Cursing ten thousand times,—with bitter rage,
The baseless whims of this *pneumatic* age.

Useless the painted pots, I say, and boxes,
Containing no ~~more~~ for the cure of p——a!

into barrels, and
for accordingly, ~~this~~ the appendix to this vol

Druggists and *herbpolists*, no more shall know
 Those blessings which from industry do flow,
 But, with apothecaries in despair,
 Shall imprecations pour on *vital air* ;
 Since vital air, though for some uses good,
 Is, when alone, but unsubstantial food ;
 And they, who feed on't, will not like their cooks,
 As meagre diet causes meagre looks.

Oh ! such a direful change must these men feel,
 They'll be the poorest in the common-weal.
 With wretchedness and need their eyes shall stare,
 Their stomachs empty, and their backs half bare.
 To Mantua, no more need Romeo go
 To buy his poison since *at home* we'll show
 Apothecaries, as wretched and as poor
 As those poor wretches who once sought for cure
 Within *their* shops ; when the *long ruffled* shirt
 Serv'd to secure their lily-hands from dirt ;
 But now, alas, so chang'd their situation !
 That, of all men, they're poorest in the nation.

E'en country *curates* not so bad as they,
 Though thirty pounds a year be all their pay.
 (*Laud !* to those bishops who enjoy, at ease,
 As many *hundreds*, as, of *pounds*, have *these* ;
 Nor ever strive to meliorate their state,
 Till *faction* thunders at the *palace-gate* ;
 But, with *such* prelates, I'll not spend more time,
 For, *Esculapius'* sons engage my rhyme.)
 Such as—*grown old*—have spent their youth in riot,
 And not provided 'gainst old age for quiet,
 Will surely live upon cameleon-diet.

No more the *powder'd* wig, gold-headed cane,
 Gold snuff box, and what else made up the train
 Of *healing* wisdom, shall to them pertain,
 Or, if they should, no more a *source of gain* *.

GENUS III.

THE APOTHECARY, WHO IS TOO WELL ESTABLISHED TO FEAR BEING INJURED BY ANY INNOVATION: BUT DOES NOT LIKE TO BE PUT OUT OF HIS WAY, AND GO TO SCHOOL (AS HE CALLS IT) AGAIN.

There are some men, says Dr. Johnson, of narrow views and grovelling conceptions, who, without the instigation of personal malice, treat every new attempt as futile and chimerical; and look upon every endeavour to depart from the beaten track, as the rash effort of a warm imagination, or the glittering speculation of an exalted mind, that may please and dazzle for a time, but can produce no real or lasting advantage.*

These men value themselves upon a perpetual scepticism; upon inventing arguments against every new undertaking; and when arguments cannot be found, upon treating them with contempt and ridicule. Such have been the most formidable enemies of the great benefactors of the world; for their notions and discourse are so agreeable to the lazy, the

* Vide the *Golden Age*, a poem, by Mr. —, apothecary, ~~farmer~~ geon, man-midwife, chemist and druggist, dentist and cupper, corn-cutter, &c. and formerly of the Barber's Company.

envious, and the timorous, that they seldom fail of becoming popular, and directing the opinions of mankind.

GENUS IV.

The Quack.

A MONSTROSITY, A FIEND OF NIGHT, WHO HATES AS MUCH THE ALL-PIERCING BEAMS OF SCIENCE AND OF TRUTH AS THE DEVIL, IN MONKISH TIMES, WAS SUPPOSED TO DREAD HOLY WATER.

SECT. XXV.

THE FRIENDS OF PNEUMATIC MEDICINE.

GENUS V.

These are indeed friends to every laudable endeavour to improve science, and more especially so important a one as that which concerns health, in which we are all interested, from the king to the peasant; there are the young under the age of forty, some few superior spirits past the age of forty; those who would not have a needless pang in the world, and consider themselves rather as guardian-angels than as vultures upon earth preying upon the mangled and bleeding carcases of their fellow creatures.

APPENDIX

TO

VOL. I.

Vo

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RECAPITULATION

OF

WHAT HAS ALREADY BEEN DONE

BY THE

OXYGEN, AND AZOTIC, AIRS.

1. HYDROCEPHALUS, OR DROPSY OF THE BRAIN.

HYDROCEPHALUS.	CIRCUMSTANCES.
<p>Case I. Lydia Johnson, under Dr. Thornton, cured. Vide No. XVIII. of the Philosophical Magazine, page 196.</p>	<p>Blindness complete, pupils greatly dilated, which originated from a putrid fever violently affecting the brain; had fits very frequent. By encreasing the quantity of vital air to 12 quarts, sight was suddenly restored whilst inhaling.</p>
<p>Case II. Thomas Mead, under Dr. Thornton. Remarkable alteration. Vide Part III. of Dr. Beddoes' Considerations, page 11.</p>	<p>Six weeks in St. Thomas's Hospital, dismissed as incurable by Dr. Fordyce. Messrs. Wathen and Phipps, oculists, thought the case incurable. Pupils dilated, pulse sluggish, subject to fits. In three days after inhaling the vital air, began to distinguish objects. Sight improved daily; his fits left him. He then left off taking the vital air.</p>

II. AMAUROSIS, OR GUTTA SERENA.

<p>Case III. Hon. Miss W —, under Dr. Thornton, relieved. Vide Part III. of Dr. Beddoes' Considerations, page 78.</p>	<p>Under the care of Messrs. Wathen and Phipps. Could not tell the hour from the Horse-Guards clock; after six weeks enabled to distinguish the hour very dily.</p>
<p>Case IV. Mrs. Benham, under Dr. Thornton.</p>	<p>In ten days after inhaling the vital air, could read a small print, which she could not do before.</p>

III. DEAFNESS FROM AN ULCER IN THE EAR.

DEAFNESS.	CIRCUMSTANCES.
<p>Case V. A boy, under Dr. Thornton and Mr. Hill, relieved. Vide Part II. of Dr. Beddoes' Considerations.</p>	<p>So deaf as not to hear the tower guns: could hear after a short time even a rap at the door, or any other loud noise.</p>

IV. OPHTHALMIA, OR CHRONIC INFLAMMATION OF THE EYES.

Case VI.	<i>Communicated by Dr. Thornton.</i>
<p>Miss Goudy, under Dr. Thornton, cured. Vide Philosophical Magazine, Number XII. page 418.</p>	<p>Miss Goudy, æt. 11, living No. 171, High-street, Shadwell, had been subject to occasional attacks of this disease for eight years past. In one attack, some years ago, a skin formed over the right eye, which was removed by a caustic powder blown into it by order of Mr. Sharp, and sight was restored in about a month: this eye has, however, since been subject to become inflamed upon the least cold, when the face enlarges prodigiously, looks red as fire, with intense burning. She had taken a great quantity of medicine under Messrs. Young, Ward, Evans, &c. without any marked advantage, previous to her parents making application to me. When I saw her, her right eye was much inflamed, and the upper lips and cheeks were tumefied in a frightful degree. It was a new case, that required much consideration. Were the vessels in a state of inflammation from tone, or from debility? Examining the arms I found them remarkably blue and mottled, the feet were always uncommonly cold, the appetite craving, or else none, much flatulent, great distention of the abdomen at times, and a tendency to chlorosis. The pulse small, and quick. I accordingly ordered the super-oxygenated air, November 27, 1798, gradually augmenting its power. Memorandum—December 4, feels always a great glow over the whole body, after inhaling the vital air. Inflammation of the eye gone. I ordered a seton in the neck, to hinder a relapse, by its inviting the blood to a neighbouring part, and setting up a new action: and without fear I now pursued the tonic and stimulant plan, viz. bark, myrrh, and steel, and a super-oxygenated air*; and my fair patient was soon perfectly cured, and continues so, I am happy to say, to this day.</p>

* The proportion was generally six quarts vital air mixed with twenty of atmospheric.

V. HEADACH.

HEADACH.	CIRCUMSTANCES.
<p>Case VII. Mrs. S — , under Dr. Darwin, cured. Vide Part II. of Dr. Beddoes' Considerations, page 63.</p>	<p>A pertinaceous headach, and so far reduced as not to be able to rise from her bed. She always, says Dr. Darwin, found herself revived by the inhalation, and gradually recovered her health, and became stronger than she had been for some years, and freer from the pains in her head.</p>
<p>Case VIII. Mr. Monier, under Dr. Thornton. Vide Part IV. of Dr. Beddoes' Considerations, page 134.</p>	<p>The headach was accompanied with stupor, and frequent giddiness, and had continued unremittingly for six weeks.</p>

VI. MANIA, OR MADNESS.

<p>Case IX. Mr. Windy, under Dr. Thornton, cured. Vide Part III. of Dr. Beddoes' Considerations, page 109, and the Rev. Mr. Townsend's Elements of Therapeuticks, Vol. I. page 2.</p>	<p><i>Communicated by the Rev. Mr. Townsend.</i> He was gloomy, sullen, and silent, or muttered only expressions which evinced the terrors of his disturbed imagination. He had no recollection of his wife or children, and the only notice he took of his attendants, was to manifest suspicion that they meant to injure him. He made several attempts to destroy himself. In ten days from the time of his inhaling the vital air, he became conscious of the presence of his wife and children, whom he called by their proper names; walked out and returned home; and before the month was concluded, recollected the money he was possessed of, sent for the guardians of his family, entered minutely into the state of his affairs, and manifested other tokens of sound intellect.</p>
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VII. EPILEPSIA, OR EPILEPSY.

EPILEPSY.	CIRCUMSTANCES
<p>Case X. M—, under Dr. Beddoes. Disease aggravated. Vide Dr. Beddoes' Considerations, Part IV. page 13.</p>	<p><i>Communicated by Dr. Beddoes.</i></p> <p>About three years ago, a Gentleman, aged 20, took an excursion on the mountains of Switzerland. In the night he dreamed of falling from a precipice, and was seized, as appeared from severe bruises on his hands, with a strong convulsion fit. Valerian and other medicines, called nervous, were administered. Sea-bathing disagreed with him; and after cold-bathing in fresh water, his fits suddenly increased from one or two in a week, to 23 in 24 hours. On discontinuing the cold bath, they diminished in frequency, and have not, for a long time, exceeded 12 in the day and night.</p> <p>The patient at first inspired a mixture of three parts of atmospheric with one of oxygen, for ten minutes at going to bed. As I then used Mendip manganese, the quantity of oxygen must be considered as less than the numbers would otherwise imply, because that manganese yields much azotic gas at the end of the process, and because the carbonic acid, which the calcareous spar it contains, was not probably all washed away. No effect being observable, next night (Saturday night) he was desired to respire for 20 minutes; afterwards he felt an agreeable glow in his chest. On Monday night, at three intervals, he respired for half an hour. I ordered him now a saline draught with 20 drops of antimonial wine; and I requested that he would drink three glasses of wine instead of four, which was his usual quantity. On Tuesday night he respired for 20 minutes. On Wednesday the air was omitted by way of precaution. On Thursday, as no suspicious effect appeared, and as he passed good nights, and for two of these days had no fits, he was ordered a mixture of oxygen one part, atmospheric air two parts; and of this he respired for half an hour, and felt uncomfortably hot afterwards. In the morning his pulse was 72, and of natural strength. He coughed slightly, but found himself very well. He had no fit all Friday. A relation who had watched him with great tenderness ever since the commencement of his indisposition, thought him <i>better</i>, and wrote a favourable account to his distant friends.</p>

Towards night the patient was unusually lively, but quite composed. The respiration of factitious gas was omitted, as I had originally determined to wait the event as soon as any distinct change should have taken place. He had scarce lain down in bed when he was alarmed with startings of the abdominal muscles, as I imagined from his description. This had ceased

before my arrival, but I found him flushed and with a pulse rather strong, and above 100. He had a constant propensity to motion, but was easily persuaded to exert himself to keep still. As he was never left alone, I was quite certain that he had taken no stimulant. His wine had been dropped this day. He appeared however as if at once a little intoxicated and alarmed. A slight fit now intervened, and increased his apprehensions. In the night he had a frantic attack, accompanied with singular agitations of the muscles, which was a new circumstance. His lower extremities were frequently in action, and his toes would move, like the fingers of a person playing on the harpsichord. But his most constant movement was that of his arms; and it was very curious, exactly imitating the gestures of a person driving a phaeton; to which the patient had been long accustomed every morning, but had discontinued it for a few days. These gestures continued frequent till Monday. He declared that he could not restrain them; and at breakfast on Monday, when he was quite sedate, seemed rather amused with his own inability in this respect. For the first 24 hours he had only five or six slighter fits; but then he had no rest till Saturday night; when he fell into a profound sleep, and had the usual number of fits of both kinds, with a paroxysm early on Sunday morning. On Monday, before day-break, he had a similar, but fainter paroxysm, which was the last. During the rest of Sunday night he slept very profoundly, as he had also done in the day-time. At this period the muscular agitations were principally confined to the fingers. He was left stiff and sore, as from severe exercise: the air was not resumed, and the patient soon became what he was before respiring the super-oxygenated air.

EPILEPSY	CIRCUMSTANCES
<p>Case XI. Miss N.—, under Dr. Thornton. Diseascaggravated. Vide Dr. Beddoes' Considerations, Part IV. page 18.</p>	<p>Miss N. had been long subject to epileptic fits. She had not however had an attack for six months. Upon inhaling the vital air on account of the loss of health, she was immediately after the trial seized with an attack. For some minutes this amiable lady remained torpid; then she violently struggled with convulsive motions of the legs, and sometimes of the arms, overcoming the strength of her attendants. She at last grew delirious; pointed to a particular spot in the room; roamed in her imagination; her eyes were fixed and glared; she now attempted to bite her attendants; and after passing three hours in this dreadful state, she fetched a deep sigh, and gradually recovered, unconscious</p>

of what had happened. She was, however, unable to stand, felt a violent head-ach, and went to bed. The next day, as was usual, she had lost her voice. In consequence of this attack, says Dr. Thornton, the vital air was desisted from for a week, during which time she had no return; but upon another trial of the vital air, the same dreadful scene was immediately renewed, and the vital air after that was discontinued, and the fits did not again recur.

Observations on this Case by Dr. Thornton.

Reasoning now on this case, I conjectured that, as the *aorta descendens* passes between the slips of the diaphragm, and this muscle partakes of the same nerve as the stomach, it seemed probable, that when this viscus was loaded with mucus, a spasm or spasms of the diaphragm might succeed, compressing betwixt its two crura the aorta: hence the difference of the appearance and feeling of the upper from the lower parts of the body. The loss of voice, the globus hystericus, and the rabies, which frequently attend these fits, seem also to prove the same sympathy; as the recurrent nerve, which supplies the throat, is a branch also of the *par vagum*; hence also when the blood was determined to the head the recurrences of the fits.

EPILEPSY.

CIRCUMSTANCES.

Case XII.

Letter from Dr. Thornton to Dr. Beddoes.

Mrs. Paynter, under Dr. Thornton.

SIR,

Acure produced.

Vide Dr. Beddoes' Considerations, Part V. page 20.

After the above-mentioned unsuccessful trials, Mrs. Paynter, who lives at No. 2, Brompton-terrace, came to consult me. She had been subject to hysterics, faintings, and epileptic fits, for more than seven years. She had no appetite, weak digestion, excessive debility, coldness of the lower extremities, flatulence, emaciation, disturbed dreams, palpitations of the heart, and great lowness of spirits. Having premised an emetic and cathartic, and cleared away the superabundant mucus of the *primæ viæ*, I then gave the vital air; and the accelerated blood meeting with no obstruction in the aorta, diffused heat through the whole system. To prevent the glands, or exhalant arteries, of these parts, from throwing out too much mucus, I next gave tonics, as bark, myrrh, and steel; and, by using occasional evacuations, continuing the daily inhalation of the vital air, after ten days the fits no longer made their appearance, and her appetite, complexion, and sleep returned; and at the end of six weeks her constitution was so firmly established, as to need no more medicine or air.

I am, &c.

R. J. THORNTON.

VIII. SCROPHULA, OR KING'S-EVIL.

SCROPHULA.	CIRCUMSTANCES.
<p>Case XIII. Miss Holmer under Dr. Thornton, cured. Vide Num- ber IX. of the Phi- losophical Maga- zine, page 90.</p>	<p><i>Communicated by Dr. Thornton.</i> Miss Holmer, æt. 18, an amiable and ac- complished young lady, the daughter of a wholesale ironmonger in the Borough*, so early as at the age of seven had the glands of the neck beginning to take on disease. First one gland under the ear then another, and by degrees all the glands about the neck became enlarged, and went on gradually increasing. The same disposition also shewed itself by an affection of the eyes, for which this lady was nine months under the care of Mr. Ware. During the progress of glandular affection, she was under Messrs. Kent, Fearon, Bayley, &c. &c. and Dr. Saunders. Mercury was used externally and internally, until the teeth became loosened; bark, and steel, and soda, or fossil alkali, given in profusion; but each practi- tioner in turn relinquished the case, recommending sea air, which was had recourse to at sundry times. This young lady was latterly referred to John Hunter, who employed hem- lock to an uncommon extent; and he also, as the sea air had been before tried without advantage, advised the parents to do nothing further, saying, with his usual bluntness, that it was a case of that nature that whoever would undertake the cure would do it only with the intent of picking their pockets. When I first saw the young lady, I observed the glands of the throat, even from the nape of the neck, so enlarged as to defeat all concealment, and forming one apparently homogeneous mass, extended even over the jaw-bones, which could not be felt, and suffocation was threatened by pressure on the wind-pipe. Her relations ridiculed the idea of any farther application for this disease: but parental fondness urged an enquiry relative to the aurs. The Rev. Mr. Townsend, rector of Pewsey, author of a very excellent work on physic, the Guide to Health, hap- pened to be at my house when the lady arrived. Although he conceived highly of pneumatic medicine, as may be seen throughout his work, he told me, "that he must consider me as "very bold if I could venture to undertake such a case, which "he acknowledged to exceed any thing he had ever before "seen;" and Mr. Jones, an eminent apothecary in Mount-street, declared, that if I produced a cure here, all he could say was "that miracles had not ceased." I, however, was not dis-</p>

* This lady had all the benefit of country air, her father having a house at Vauxhall, and keeping his carriage.

couraged, and the event has proved that we should not, having such new and powerful agents as the airs, readily give way to despair. In a month after commencing the inhalation of vital air (six quarts daily mixed with thirty of atmospheric), the knot of glands began to soften, yielding a little to external pressure: by degrees they separated from each other, and thirteen glands could be directly made out: the jaw-bones became liberated; and these, whether from pressure of the glands, or imperfect ossification, were bent up a little from their natural course; and, not to tire the reader, I shall finally remark, that in less than eight months the decrease was five inches by measurement round the neck! The hands, which before were unusually cold, were comfortably warm during the whole time the vital air was inhaled, and the appetite and spirits increased. Mr. Cruickshank observed, that during the time of inhaling the superoxygenated air, the pulse was raised about six beats in a minute, and became stronger. I must beg leave to mention here, that I also roused the absorbents by both topical as well as internal remedies. But why I place such a stress on the power of the vital air over this system of vessels, is, that from the experiment of Dr. Beddoes, which he made upon himself, while inhaling a superoxygenated air, he became, he observes, considerably diminished in bulk, although he eat twice as much before, which I conceive could only arise from the superior energy given to the absorbents by the vital air.

SCROPHULA.	CIRCUMSTANCES.
<p>Case XIV. Mary Buchanan, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page 144.</p>	<p><i>Letter from Dr. Thornton to Dr. Beddoes.</i> Mary Buchanan, aged 8, lives at No. 2, Whitcomb-court, Hay-market; from the account of her mother she was weakly from her infancy. She was two years and a half before she walked; her limbs were crooked, understanding remarkably acute, under lip prominent, eyes black, hair lank; was troubled with worms, both the tætes and ascarides; for which she took Evans's powder, which brought away much slime, and many worms: but, from these powerful evacuations, she was much debilitated, and became subject to profuse perspirations, and for a long while was constantly ailing; when, whether from cold, or what other cause, or the nature of scrophula, I cannot determine, she was seized with deafness; and afterwards with such an inflammation of her eyes, that she was blind for above ten days: leeches were applied to the temples with some effect; but these symptoms only seemed to retire, to give way to a more formidable symptom, namely, an enlargement of a gland of the</p>

neck on the left side, which, for three months, kept on increasing both in size and hardness; and the child continually leaning on that side, the head became immovably sunk; so that the ear, night and day, nearly rested on the left shoulder. The countenance of the child was pale, body costive, belly large and hard, breath offensive, particularly so towards morning, feet cold, itching of the nose, appetite often keen, but there was no starting in her sleep, grinding of teeth, or any worms observed in her evacuation, although much mucus. She was placed, and continued under the care of my friend Mr. Hill, a week. He gave her rhubarb and vitriolated kali night and morning. Sorrel poultices were applied to the neck, the vital air was inhaled, and the case was going on very well, when Mr. Hill had occasion to leave town, and it then entirely rested upon me. I followed Mr. Hill's practice, and in addition employed electricity on the tumour, and directed a tonic mixture of bark and steel, keeping the body gently open with the powder. The tumour was at this time the size of a goose's egg, and very hard. Since the application of the sorrel, it was looking somewhat red. In a week there was produced a considerable softening, accompanied with violent pains and restless nights. I ordered an opiate in the evening. In a few days after this I made a scratch, on the most depending part, with a lancet, and repeating this three successive days, on the fourth there issued through this small orifice a bloody serum. I now directed a bread and milk poultice, discontinued the opiate, and increased the proportion of steel. For several days the bloody serous discharge continued, when I ordered the sorrel poultice to be resumed. Almost instantly the purple tumour was rendered florid, the lips of the orifice became of a bright red, violent pain was excited, and, on the next day, matter of some consistency was formed. I moderated the action, when too strong, by a bread poultice; and I sometimes interposed the rhubarb aperient; and, by always keeping up a due action, in a month the tumour was wholly removed; the child can now turn her head in all directions; she has the appearance and manners of health; and, instead of being disfigured, there remains now a scar not larger than a pea, and not discernible but upon the closest inspection.

SCROPHULA.	CIRCUMSTANCES
<p>Case XV. Mr. Cooper, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 71.</p>	<p><i>Letter from Mr. Cooper to Dr. Beddoes.</i> Dacre-street, Westminster, July 29, 1795. SIR, I was above nine months afflicted with hard tumours, which were very slow to suppurate, and when they did, produced only a watery discharge, and a sore, that</p>

took a long time in healing. These appeared chiefly about the throat. Previous to this, I had frequent eruptions on my face, for which I was often purged and bled, which in my opinion might have produced the disorder I am attempting to describe to you. It soon became necessary to try every means to get rid of it, and I took a vast quantity of different medicines; but the tumours continued rather to increase in size and number, and produced a continual inconvenience to me. As the vital air is said to alter the character of the blood, and I conceived my case arose from a broken state of blood, I waited on Dr. Thornton, who thinking these tumours very likely to be removed by the air, wished me to make the trial. At that time several of the tumours were commencing, others were upon the point of breaking, and others again were in a state of open sore. My bowels were first cleared, and I inhaled the vital air, and took bark twice a day in powder. The effect the air had on me was, as my mother and sister observed, to make me eat more than usual. I felt uncommon spirits, and no longer complained of chilliness. The tumours that were in their first state, disappeared; the others looked redder and gave me more pain, and discharged matter. But in a fortnight these also yielded to the air and disappeared, and I was cured. But what surprised me most was the change it produced in my eyesight. My eyes for the space of fifteen years had been uncommonly weak; so weak, that I was never able to read or write by candle-light, but from inhaling the vital air, they have acquired such strength, that latterly I have sat up writing in my books, sometimes from twelve to one o'clock, without feeling my sight the least fatigued. My mother used to attribute my weakness of sight to my having had the measles very bad. I am at the present time perfectly well, and without any fear of my former afflicting disorder.

I am, Sir,

With the greatest respect, &c.

HENRY FREDERICK COOPER.

SCROPHULA.

Case XVI.
Mr. —, under Mr.
Barr, cured. Vide
Dr. Beddoes' Con-
siderations, Part I.
page 60.

CIRCUMSTANCES.

Letter from Mr. Barr to Dr. Beddoes.

Birmingham, 14th March, 1795.

DEAR SIR,

Having a very high opinion of the effects to be expected from the practice which you have so benevolently promoted; and wishing to encourage farther experiments upon a subject so interesting to humanity, I take the liberty to communicate to you some observations which I have made on the effects of different factitious airs in the cure of scrophula.

About four months ago, a gentleman of this neighbourhood applied to me for advice in the management of a scrophulous ulcer of considerable extent. He had tried various remedies, but had derived no lasting advantage from any of them. When I first visited him he was worn down by a long course of night watching. The deep-seated pain of the arm was so constant and severe, that it had in a great measure deprived him of sleep. His countenance was pale and sickly; his limbs were continually afflicted with aching pains; every exertion, even the most gentle, seemed beyond the measure of his strength, for his body had lost much of its active power, and his mind much of its wonted energy. The discharge from the ulcer was copious, thin, bloody, and corrosive; and besides, the whole surface of the sore was so exceedingly irritable, that the mildest dressings, applied in the gentlest manner, produced very severe and lasting pain. During the first six weeks of my attendance, he regularly took as much Peruvian bark in substance as his stomach and bowels could bear; and the ulcer was dressed with various emollients, sedative, and astringent applications, but without any permanent advantage. I then recommended a trial of oxygen air, which was readily complied with. He began by inspiring four ale quarts diluted with sixteen of atmospheric air twice a day, and gradually increased the quantity of oxygen to a cubic foot and a half in the day; by pursuing this plan for about a month, his health was wonderfully improved, but the ulcer shewed no disposition to heal. The deep seated pain was now entirely removed, but in the space of a few days more, he complained of a burning sensation over the whole surface of the sore, similar to the pain arising from erysipelatous inflammation. This unpleasant sensation first commenced after inspiring the whole quantity of oxygen in the space of two hours, which before had been taken in equally divided portions morning and evening. We still pursued our plan, thinking that this new pain might be owing to some accidental circumstance, and that it would soon pass away. But it every day continued to increase, and the ulcer began to spread wider and wider. The edges became thick, and were turned outwards, and the discharge became more thin and acrid.

In this situation, a local application seemed proper. I wished to have applied hydrocarbonate externally to the ulcer, but this, from some circumstances of the case, was not practicable. I then thought to moderate the stimulus of the oxygen by a mixture of hydrocarbonate, which Mr. Watt told me would occasion no chemical change in the two airs. Accordingly a mixture of three parts of oxygen, and one of hydrocarbonate was prescribed. Four quarts of this mixed air were added to about sixteen of atmospheric, and this quantity inspired morning and evening. In less than a week the burning sensation was much diminished, and the ulcer put on a more healing appearance.

The mixed air was then increased to five quarts, and used as before, which produced an increase of all the good symptoms. After a few days trial of this proportion of the mixed air, six quarts were prescribed. This is the quantity now inspired morning and evening.

My friend, at present, enjoys good health and a good appetite, and feels himself as strong as at any former period of his life. The ulcer is now reduced to less than half its original size, and healing rapidly. There is neither superficial nor deep-seated pain remaining, and the motion of the joint, and the action of the contiguous muscles are free and easy.

I am, dear Sir, &c. &c.

JOHN BARR.

SCROPHULA

CIRCUMSTANCES

Case XVII.

Mr. —, under Mr Barr, cured. Vide Dr. Beddoes' Considerations, Part IV. p. 155.

Letter from Mr. Barr to Dr. Beddoes.

Birmingham, Aug. 20, 1796.

DEAR SIR,

I transmit to you the following ideas on the effects of factitious airs in cases of surgery, to induce the humane practitioners of that art to extend the application of them.

In the management of large ulcers, when the discharge is thin and copious, the great desideratum is to increase the absorption: for, unless secretion and absorption maintain a just equilibrium, a cicatrix can never be formed. But the most skilful surgeons frequently know not how to accomplish this end. The whole list of general and topical remedies at present known, however judiciously applied, are always slow in their operation, and sometimes entirely fail in producing the desired effect.

A patient of mine, afflicted with scrophulous swellings and ulcerations, who had for some time inhaled oxygen an, and had been much improved in his state of health by the medicine, desired me one day to examine his head, as he feared some fresh ulcers were about to break out there. Upon examination, I found the skin raised in several places, by collections of effused lymph; each tumour containing apparently from half an ounce to an ounce of fluid. In this manner, he informed me, the complaint usually began; the lymph gradually accumulating till it produced inflammation of the skin, and an ulcer, extremely difficult to heal. The process followed exactly the same course when he inhaled oxygen. A mixture of oxygen and hydro-carbonate was then tried: the fluid was soon completely absorbed, and the tone of the relaxed skin perfectly restored. The experiment has been repeated five or six times on the same and other patients, and has uniformly produced the same effect.

I am, respectfully, your's,

JOHN BARR.

IX. HYDROTHORAX, OR DROPSY OF THE CHEST.

HYDROTHORAX.	CIRCUMSTANCES.
Case XVIII. Sir William Chambers, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. p. 3.	Having been informed, says Dr. Beddoes, that Sir William Chambers, when labouring under the pressure of unspeakable distress, had derived more than present relief from oxygen air, I requested from him an account of the effects he had experienced from it, and received the following letter:

*Letter from Sir William Chambers, Knight of the Polar Star, F. A. S.
&c. &c. to Dr. Beddoes.*

Upper Norton-street, June 20, 1795.

SIR,

As every person of a benevolent mind and enlarged understanding must approve of the design of those gentlemen who are endeavouring, from a philosophic induction, to introduce aerial remedies for the removal of otherwise incurable diseases; and as my case appears such as to demonstrate the efficacy of the vital air in a disorder that has hitherto resisted the ablest practitioners in physic, I will attempt, as far as lies in my power, to describe my situation, and the effects which I experienced from this new remedy, and shall be truly happy should the same advantages be felt by others under similar circumstances.

Previous to my coming under Dr. Thornton's care, every means which extensive experience and great abilities could suggest, had been tried by my friend Dr. Turton. My complaint seemed to be of such a nature as to baffle all the powers of art. I was at that time hardly able to move from one chair to another. It was with the utmost difficulty I could get up stairs. I had water in both my lower extremities, and great oppression on my breath, so that when I lay down to sleep, I was frequently obliged to start up and resume an upright posture, to prevent myself from being, as it were, suffocated. My nights were bad, my appetite gone, and for months I had not been able to swallow any thing solid. Indeed I had given myself up as a lost man, until I heard of the vital air, which my friends told me had done such extraordinary things in medicine and surgery. I conceived that as the application was to the seat of the disease, it promised more than most other remedies, and accordingly, about ten months back, I began the inhalation of this air. Dr. Thornton approved of the plan of medicine I was pursuing, which was bitters to strengthen the system, and as occasion might require, a warm laxative pill; these

were therefore continued. After a few weeks trial of this new mode of treatment by the vital air, the above medicines being continued, my strength was so far recruited, that from my own reckoning, I could walk upwards of two miles; my ankles did not pit; my breathing was relieved; my appetite improved; and my countenance so much mended, that all my friends, together with my physician, congratulated me on my recovery. I was able to pay my respects to his Majesty, who complimented me much on my good looks, and made many inquiries respecting the vital air. I was enabled regularly to attend the Board of Works and the Royal Academy. But I had to battle through such a winter as few, at my time of life, have been able to support. The influenza, which was general, was a great drawback to my full restoration, as the vital air was obliged to be desisted from at that time, and recourse was had to evacuations, cooling medicines, blisters, cupping, and a low diet. But this, together with several colds that have occasionally attacked me, has, in my mind, only manifested the more the efficacy of the vital air in my complaint; for as soon as it has been judged prudent to have again recourse to the vital air, the symptoms that had gained ground during the intermission, have been as constantly subdued, and my friend Dr. Turton has told me, "that I could not do better than to go back to the vital air," to which I do not hesitate to ascribe my present freedom from oppressive respiration; comfortable nights; clean ankles; power of eating solids with appetite; and, in a few words, as much return of health, as a person at my time of life, 75, has reason to expect after such an attack, and I think abundantly sufficient to be thankful for, and to prove the virtue of the vital air, in all complaints of this nature; but this I must leave to you, Dr. Thornton, and others to determine, to whom I sincerely wish every success in your laudable attempts to lessen the afflictions of mankind, and have the honour to be,

Dear Sir,

Your obedient humble servant,

WILLIAM CHAMBERS.

HYDROTHORAX.

CIRCUMSTANCES.

Case XIX.

Mr. Barbor, under
Mr. Barr, cured.
Vide Dr. Beddoes'
Considerations,
Part III. page 13.

Letter from Mr. Barr to Dr. Beddoes

Birmingham, Oct. 9, 1795.

DEAR SIR,

I announce to you with much pleasure the cure of a case of hydrothorax, which had existed for a considerable time notwithstanding the application of known and approved remedy, had reduced the subject nearly to the last stage of human suffering.

Mr. Barbor, of Barton under-Needwood, being in this town on a visit to a friend in the spring of 1793, was seized with an highly inflammatory fever, attended with a violent pain of the side. This fever was followed by a dry tickling cough, shortness in breathing, much languor, and a great thirst, and anxiety. His bowels felt full, tense, and uneasy, and he complained that his urine was scanty, and did not flow freely, and that he felt the sensation of not having evacuated himself. He took, however, of tincture of mercury, and a decoction of Peruvian, and afterwards of Angustura, bark and iron, as prescribed. He was relieved by these medicines, but he did not recover his strength nor his spirits. In this situation nearly he passed the remainder of the year in the country; in the spring of 1794, he came to Birmingham again, with all the symptoms of his disorder increased, particularly the oppression in breathing. He could neither lie down in bed with comfort, nor ascend the smallest acclivity without the greatest uneasiness. His urine was diminished in quantity, and voided with difficulty. A decoction of yew-root, and small doses of digitalis, were directed and continued for two or three weeks; but they rather seemed to amuse than relieve him. He called on me again last April, and told me that all medicines had lost the power of relieving him; that his breathing was now more generally difficult, that his urine was very scanty, and that his appetite was entirely gone. I proscribed the digitalis with a bitter infusion. He went into the country, and continued these medicines for some time. Towards the end of July he called upon me again; but, alas! how changed! His face was now become pale and emaciated, his eyes stared as if taking a last conscious view of their object; which last circumstance much alarmed his friends. His legs were swelled to such a degree that the skin was become much inflamed, and in danger of bursting; he made very little urine; he could not endure an horizontal posture for a moment, but was under the necessity of being bolstered upright in bed through the night; even then he slept little, and that little was disturbed and unrefreshing, for he frequently started from his sleep, under an impression of instant suffocation.

Having seen an account of the happy relief Sir William Chambers had experienced from oxygen in a similar situation, I wrote to my patient, and advised the adoption of the pneumatic plan. I did this, I confess, in the present instance, with little hope of advantage; but as the most powerful medicines had produced no salutary effect, I felt it my duty to him, as well as to the use of humanity, to urge his compliance. I procured him a supply of oxygen, and the similarity of the circumstances striking, that he agreed to place himself immediately under my care.

He arrived here on the 12th of August, and began to inspire the factitious air on 15th. I directed one quart of oxygen, mixed with nineteen of atmospheric air, to be inhaled every day; but as the symptoms were become extremely urgent, I thought it right to join the use of those active medicines that I had prescribed for him before. Accordingly I directed him to take half a grain of digitalis in substance, every evening, and four ounces of a decoction of Augustura bark in the course of each day. On the third night after inspiring, he found himself more composed, he could remain longer in one posture, and the startings during sleep, seemed both less frequent and less violent. Every night he was sensible of amendment; in ten days he could bear the removal of several of the pillows that bolstered him up in bed; and he could sleep for three or four hours without one starting fit. The swellings of his legs too began now to subside; the tenesmus was entirely removed; the quantity of urine was much increased, and he could walk up stairs with much ease; his appetite and cheerfulness began to return, and the pale face of disease to give place to the florid countenance of health. In the course of the second week I had gradually increased the quantity of oxygen to two quarts a day, diluted as before. In four weeks from his beginning to inspire the vital air, not a vestige of the disorder remained, except *weakness*; he could lay his head as low in bed as when in perfect health, and sleep the whole night; no swelling of the legs remained; no difficulty of breathing upon ordinary exertion; and every function was performed with regularity and ease. He then went home provided with a pneumatic apparatus, and directions how to use it, and laid aside the use of all medicines, except a laxative pill occasionally. He passed through this town yesterday in perfect health. His strength, agility, and vivacity, are greater than in most men at his age (60).

This case, in my opinion, will add much to the credit of the pneumatic remedy; for though I employed medicines along with the oxygen, yet let it be remembered, that the same medicines had been repeatedly taken without advantage, and before the disorder had made such an alarming progress; add to this, that, during the intermediate periods of the little history which I have given, Mr. Barbor had consulted some of the ablest and most experienced Physicians of the present age, and faithfully followed their directions without any material benefit. May we not therefore conclude that the art of medicine had exhausted all its resources without effect, and that this gentleman had remained a devoted victim, had not this *new* friend to mankind stretched forth her benevolent hand and snatched him from misery and death? This is the opinion of the worthy gentleman himself, of his family, and friends who have witnessed the whole proceedings, and have desired

me to make it thus publicly known, that those in similar circumstances of distress may be encouraged now to hope for a return of ease and health.

I am, dear Sir,

Your's, very respectfully,

JOHN BARR.

HYDROTHORAX.

CIRCUMSTANCES.

Case XX.
Mr. W—, under Dr. Darwin, not cured. Vide Dr. Beddoes' Considerations, Part III. page 27.

The patient was aged 60, the hydrothorax had been increasing two years, he inhaled the superoxygenated air a week. It was then left off for a fortnight, and then resumed and taken for a fortnight again, pure, and then left off; after which, for a few weeks, other medicines were employed, and the patient died.

Dr. Darwin observes, when relating this case, that it is probable, that the quantity of oxygen gas would have had greater effect, if it had been respired in a more diluted state. It was also unassisted by medicine.

Case XXI.
Mr. G—, under Dr. Beddoes, relieved. Vide Dr. Beddoes' Considerations, Part I. page 164.

This patient æt. 60, after living very freely, had dropsical symptoms. He underwent a long course of violent cathartics, and afterwards came to Bristol Hotwells. The paralytic appearances were so striking, that I declared to his friends, in the most positive terms, that I apprehended he would in no long time die suddenly. The digitalis (which I have seldom seen to fail in cases of this kind) procured a discharge of the water. It repeatedly collected, and was as repeatedly evacuated by the digitalis, and once or twice by squills and the pulvis ari comp. The medicines had now no sooner ceased to operate, than a relapse followed, and threatenings of apoplexy were several times observed. At this period oxygen air, mixed with twice its bulk of atmospheric, was administered for the space of one minute, four times a day. During the whole course of his disease, the patient had that tendency to sickness and vomiting, which the long abuse of fermented liquors produces. The modified air was found by the patient to relieve these symptoms; and by respiring it, he said he could prevent and remove nausea. From his observations I think oxygen air more likely than any thing else to carry off violent affection of the stomach, arising from an over-dose of digitalis. The difficulty of breathing was always relieved by his mixed air, though only for a short time.

In less than a month, he by degrees came to respire for 15 minutes in a day. The swellings, however, increased, and there were evident signs of effusion in the thorax; so that the oxygen did not appear, in this instance, to render the absorbents more irritable.

X. ASTHMA.

CIRCUMSTANCES.

Case XXII. *Letter from James Hare, Esq. M. P. to Dr. Beddoes.*

James Hare, Esq.
M. P. under Dr.
Beddoes, cured.
Vide Dr. Bed-
does' Considera-
tions, Part IV.
page 49.

SIR,

I very willingly consent to your publishing my case, in hopes that other persons may obtain relief from similar treatment. For near *eleven* years I have been subject to frequent attacks of nervous asthma, under which I suffered inexpressibly. Blisters on the chest, with expectorant medicines, usually relieved me, though not till after many hours of agony. I was troubled with this disorder more in damp than in frosty weather. If I caught cold, I scarcely ever escaped it. My strength and spirits were very much affected for a long time after the difficulty of breathing had left me. About the middle of September last (1795) I began to take oxygen air, by the advice and under the direction of Dr. Beddoes. In a few weeks there was a sensible and visible improvement in my general health. Towards the end of October I caught cold, and had a pretty severe fit of asthma, though much less so than many former ones. From that time to the present, I have only had five attacks, all slight in degree and short in duration. For many years past I have suffered much from illness in the spring; but this spring I have not been confined for one hour; and, during the whole ten months I have enjoyed a much better state of health than for many preceding years. Hot rooms and damp weather affect me much less than formerly; and I have caught cold several times without its bringing on an asthmatic fit. Having taken the oxygen air once a day (with few interruptions) for about nine months, the beginning of this month I discontinued it; in hopes that I, through the summer without its aid, and so reserve it for exigencies.

J. HARE.

ASTHMA

CASE XXXIII.
 Mrs. Green, under
 Dr. Beddoes, cured.
 Vide Dr. Beddoes' *Considerations*,
 Part IV. page 59.

CIRCUMSTANCES

Dr. Beddoes, in his *Considerations*, says he has before him two letters from Francis Green, Esq. of Denmark Hill, Camberwell, respecting one of his daughters, aged 18, who had been for several years violently afflicted with spasmodic asthma. The letters are dictated by that warmth of kindness, which an affectionate parent feels towards those whom he considers as having been instrumental in rescuing his child from an obstinate and most violent disorder. The following are the facts stated by Mr. Green. The paroxysms, before the patient's arrival at Bristol Hotwells, in October, 1795, had "come on" periodically once a week. There she grew much worse, "until some short time after I had the pleasure of meeting with you. I must acknowledge I think the vital air has been wonderfully serviceable to her." This letter is dated September 14, 1796. The essential part of the 2d letter runs as follows:

Brighton, September 7, 1796.

SIR,

My dear daughter, as well as my whole family, have every thing to thank you for. The morning we left Chilton, turned out very bad. We had wind and rain nearly all the way to Oxford; what increased our fears most was, we lost the air from the air-holder, it being unsoldered. We spent the next day there, and although the weather continued very indifferent, to my great surprize my daughter remained well.

The day following we reached home, and waited with anxiety for the apparatus, fearful of the return of the complaint, but to our great joy I assure you she has not had a fit since. We have continued the use of the air, except at short intervals, and about two months back took her to Brighton by way of trial, but the second day after our arrival, (the weather was very changeable) perceiving a weakness in her eyes, which I have always considered as a symptom of the old complaint, we returned immediately to our house in Camberwell, where after staying a short time, the weather coming on fine, we came again to this place for another trial, and have the satisfaction to say she has continued well without the use of the oxygen air.

I am, dear Sir, &c.

FRANCIS GREEN,

Observation by Dr. Beddoes.

The two preceding cases came under my own observation. They were among the worst in their kind; and the event, as far as we can perceive at present, has been eminently successful. Mr. Hare and Miss Sarah Green I saw every day for three or four weeks. These the fits were very frequent

and severe; but they were in other respects such as are commonly to be observed in spasmodic asthma. I do not therefore think it necessary to enter into any discussion concerning the symptoms. But there are a few facts which it would be unfair if I were to conceal from the reader. Mr. Hare began with one quart of oxygen air to above twenty of atmospheric, twice a-day—he never exceeded three quarts of oxygen at one dose. The morning after the sixth dose he observed some streaks of blood on a small quantity of mucus, which he had expectorated. This was not attended, nor to the present day, (Sept. 23, 1796, on which I have seen Mr. H. in excellent health) has it been followed by any suspicious symptom. From my idea of the stimulating power of oxygen gas, I felt some alarm, and persuaded my patient to desist from the use of the air for a day or two; and at this moment I believe that I should have advised the entire discontinuance of it; but Mr. H. who laid no stress upon the occurrence, was little disposed even to procrastination; and he expressed a firm resolution to run some risk in order to procure an abatement of his harassing complaint. He accordingly went on respiring diluted oxygen till the time specified in his letter, since which he has not resumed it. Like many other asthmatics, he was particularly liable to catarrh; in consequence of which he never failed to have a paroxysm. Apprehending he had taken cold once or twice during the first fortnight, I ordered him four or five grains of antimoniæ powder at bed-time. Dr. Thornton*, in consideration of his weakened habit, had before suggested to him the propriety of taking tonic medicines. I did not scruple to order pills of equal parts of extract of gentian and sulphate of iron (green vitriol), of which, after leaving Clifton, Mr. H. took six or eight grains a day for some time. For this twelve-month past he has not taken an atom of any opiate or any antispasmodic medicine. The apparent improvement of this gentleman's constitution is, in my opinion, still more remarkable than the diminished frequency and force of his disorder. Oxygen air has frequently enabled persons to bear cold better; and I have met with no one who seems to have experienced this agreeable change to a greater degree than Mr. Hare. When I was called to Miss S. Green, I found her labouring under an attack of asthma, which with some small remissions, continued three days and nights. Her fits had been of late so severe as to give her friends the idea of immediate ~~death~~ ^{recovery}. Besides oxygen air, she has taken the mineral solution of Fowler, ipecacuanha in small doses, and likewise as Mr. Cree informs me, five or six emetics since October, 1795; an emetic having been given when she perceived a huskiness in her throat; I suppose lest a fit of asthma should come on after a catarrh.

* Dr. Turton recommended Mr. Hare to Dr. Thornton, who advised this gentleman, as it was hot weather, to leave London, and inhale the oxygen air under Dr. Beddoes.

AUTHOR.	CIRCUMSTANCES.
Case XXIV. Boothby Clopton, Esq. under Dr. Thornton, cured. Vide Dr. Beddoe's Considerations, Part III. page 21.	<i>Mrs. Boothby Clopton's replies to Queries re- specting her personal experience of the inna- lation of vital air.</i> <i>Letter to Dr. Beddoe from Dr. Thornton.</i> Duke-st. Ct. Gro. N. W. quare, July 13, 1795. It is with great pleasure I send you the enclosed letter proposing queries to Mr. Boothby Clopton.

Dr. Thornton's letter to Mr. Clopton.

SIR,

As Sir William Chambers, and other Gentlemen of rank and character in England, have consented to authenticate the effects of the vital and other aerial remedies on themselves, and as my motive for this application is no other than the extension of the most important of the sciences, I am emboldened to request the same favour of you. You, Sir, are so well known to move in the highest sphere of life, that your testimony will greatly contribute to draw attention towards an investigation, which I have no doubt will *finally* be productive of much general good. Permit me then to request your answer to the following queries.

1. What was the nature of your indisposition?

Ans. Asthma, accompanied with great debility.

2. How long had you been ill previous to your coming under my care?

Ans. Seven months.

3. Did the Gentleman who attended you, make any objection to your trying the vital air, or did he suppose other medicine would have had equal efficacy?

Ans. Sir Walter Farquhar had no objection, medicines having been so long used without effect.

4. Was the disease after a time alleviated?

Ans. Immediately on my inhaling the air, I was less oppressed with asthma, and slept better the first night than I had done for seven months.

5. Did you find any alteration in your strength and spirits?

Ans. My strength and spirits were certainly increased.

6. Did your friends observe any alteration in your countenance?

Ans. Not only in my countenance, but in my person, for my nights being rendered good, I increased considerably in weight.

7. Has the advantage been permanent?

Ans. I inhaled the vital air in the winter, and am now in perfect health; and as I took no medicine, I am convinced my recovery proceeds solely from inhaling the vital air.

ASTHMA.	CIRCUMSTANCES
<p>Case XXV. Rev. Dr. B—, under Dr. Thornton, cured. Vide the Rev. Mr. Townsend's Guide to Health, Vol. I. p. 398.</p>	<p>The Rev. Dr. B—, an intimate friend of the celebrated oculist Mr. Wathen, had for more than two years been afflicted with asthma. The paroxysms were singularly severe, so that he could not breathe but in a contorted position of his body; they recurred regularly each night, and lasted in general from five to seven hours. Being quite exhausted, he would at length fall</p>
<p>asleep, but awoke</p>	<p>with a parched tongue and very languid.</p>
<p>He had been under the care of several very eminent physicians, and latterly under Dr. Warren, who told him, with his accustomed liberality, that he was persuaded, from a very extensive experience, that asthma, when once fixed in the habit, was not to be removed by art, however it might be palliated, and he must not therefore entertain the fallacious hope of a cure from medicine, and fly from physician to physician, but must patiently resign himself to the affliction. But daily losing flesh and strength, his family began to be very apprehensive, and Mr. Wathen having told them of the extraordinary relief and final cure, obtained by a young lady of his acquaintance, in the most violent spasmodic attacks*, when the prescriptions of the ablest physicians could render her no service, and that an asthma even of forty years standing had been greatly relieved by the inhalation of the vital air, this gentleman was encouraged to confide himself to the care of Dr. Thornton.</p>	
<p>In ten days time, by cleansing the stomach of viscid mucus, and restoring the vital principle to the blood, his paroxysms were somewhat less violent; after which, by strengthening the system, and still continuing the inhalation of an oxygenated atmosphere, he had several intermissions, and in two months he was perfectly free from asthma.</p>	
<p>He continued throughout the whole of last winter perfectly well, and at the present time is, as Mr. Wathen informs he, in the full enjoyment of the blessing of health.</p>	

* Vide Case XXXIV.

ASTHMA.	CIRCUMSTANCES.
<p>Case XXVI. Mr. Stepney's two servants, under Dr. Thornton, cured. Vide Dr. Beddoes's Considerations, Part IV. page 50.</p>	<p><i>A letter from Mr. Phipps, Surgeon and Oculist in Ordinary to his Majesty, to Dr. Beddoes.</i></p> <p style="text-align: right;">Pall-Mall, August 8, 1796.</p> <p>SIR,</p> <p>Mr. Stepney having mentioned to me that a servant who attended him had been afflicted with a spasmodic asthma above thirty years, I recommended Mr. S. to place him under the care of Dr. Thornton. Accordingly he did so. He was ordered a more generous mode of living; and whenever his disease has threatened an approach, it has been invariably put off by inhalation of vital air. During the last eight months, he has had but two paroxysms, which were so slight as not to confine him to his bed, as formerly; and I should add that his son, who, upwards of seven years, had constant dyspnœa, with frequent spasmodic attacks of asthma, was also cured four months ago by the same remedy in seven days, and when I saw him lately he was blooming, and in perfect health.</p> <p>I remain, Sir, &c.</p> <p style="text-align: right;">J. W. PHIPPS.</p>
<p>Case XXVII. Mrs. Barrett, under Dr. Thornton, cured. Vide Dr. Beddoes's Considerations, Part III. page 26.</p>	<p><i>A letter from Mrs. Barrett to Dr. Beddoes.</i></p> <p style="text-align: right;">Queen-square, Westminster, July 12, 1795.</p> <p>SIR,</p> <p>My asthma had afflicted me three years. It attacked me very violently at times, the fit going off generally with expectoration, leaving me very low and weak. The last winter it was uncommonly severe, and latterly, for months, I had not known what it was to enjoy a comfortable night's rest. As a tradesman in our neighbourhood had been just cured by Dr. Thornton, by means of vital air, of an asthma of thirteen years standing, I resolved to put myself under that physician's care, though before this, I had made up my mind to try no more medicines. I inhaled the vital air from a large bell glass, and its effect was so immediate, that on the second night I slept the whole night through. My attacks were less frequent, and milder, and pursuing the vital air for six weeks, I got free of my complaint. With the blessing of God, I have continued since in perfect health, except I catch a bad cold; when my asthma recurs, but then in a very slight degree.</p> <p>I am, Sir,</p> <p>Your obedient humble servant,</p> <p style="text-align: right;">ELIZ. BARRETT.</p>

Observation on this Case by Dr. Thompson.

The tradesman, whom Mrs. Barrett mentions in her letter, is a baker in Tottul-street. He certainly obtained considerable benefit, and when I sent on the 20th of July, 1795, to enquire how he continued; the answer returned was, "that he had not enjoyed such health, as at present, for years."

ASTHMA	CIRCUMSTANCES
<p>Case XXVIII. Mrs. Howlet, under Dr. Redlearn, cured. Vide Dr. Beddoes' Considerations, Part II. page 28.</p>	<p><i>Letter from Dr. Redfearn to Dr. Beddoes.</i> Lynna, Norfolk, Oct. 1, 1795</p> <p>SIR,</p> <p>Elizabeth Howlet, aged 11 years, has been afflicted with a pituitous asthma upwards of sixteen years, attended with dyspnoea, troublesome cough, and a copious expectoration. She is also subject to flatulency, loss of appetite, and has great debility. Her countenance is pale and somewhat bloated; her pulse was 100, weak and tremulous. Last May she began to inhale four quarts of oxygen diluted with eighteen of atmospheric air, every evening. The oxygen was gradually increased, and during the last two months, she has inhaled daily twelve quarts of oxygen mixed with ten of atmospheric air. Sometimes she has inhaled a cubic foot of recent oxygen undiluted, without experiencing any bad effects from it. She only mentioned a sensation similar to that from drinking peppermint water, and an agreeable glow in her chest, and after inhaling this quantity her sleep was always sound and undisturbed by coughing. September 20, she now relinquished the inhalation with much regret, after having used it for four months. The dyspeptic symptoms are entirely removed, and she is now enabled to make her own bed, which she had not been able to do for <i>ten years past</i>; she has also acquired a degree of corpulency which has surprised all her friends, and the livid appearance at the extremities of her fingers has totally disappeared; her cough and expectoration are much mitigated; and her countenance appears more healthy than before; her pulse is now about 70, natural, and increased in vigour; her appetite is very good, and she sleeps well.</p>

XI. DYSPNŒA.

	CIRCUMSTANCES.
<p>Case XXIX. Mrs. —, under Dr. Thornton, cur- ed. Vide Dr. Bed- does' Considera- tions, Part III. page 29.</p>	<p><i>Letter from Mr. Phipps, Surgeon and Oculist in ordinary to the King, to Dr. Beddoes.</i> Pall-Mall, Aug. 5, 1795.</p> <p>SIR,</p> <p>Understanding that you are collecting ac- count of the various effects either seen or felt from the vital air, I embrace the pre- sent opportunity of transmitting the result of two cases which came under my particular notice. I was first induced to recommend the vital air, from observing the very happy and immediate effect it had in removing violent spasms which had resisted, in a relation of mine, all medicines for above three years*. Soon after, a very corpulent lady, of about 60 years of age, applied to me for a chronic inflammation in her eyes: besides which, I found she laboured under the greatest possible difficulty in breathing. She could not even walk from the coach into the house, without stopping more than once to recover her breath. After ordering what appeared to me ne- cessary for her ophthalmia, I recommended her to the care of Dr. Thornton for her dyspnœa, requesting to see her in a week. In this short space of time the amendment greatly exceeded my expectations. She had walked above a mile to my house; her respiration had become almost free; and her nights better than she had enjoyed for a long time. She continued the use of the oxygen air for a month, and was most perfectly cured, and has never had any relapse.</p> <p>I remain, Sir, Your obedient servant, J. W. PHIPPS.</p>
<p>Case XXX. Mr. Colvin, under Dr. Thornton, re- lieved. Vide Dr. Beddoes' Consid- erations, Part IV. page 69.</p>	<p><i>Letter to Dr. Beddoes.</i> Duke-street, Grosvenor-square, July 2, 1796.</p> <p>DEAR SIR,</p> <p>The subject of this report is a very cor- pulent gentleman, who had been afflicted, more or less, with dyspnœa for twenty years, and under different physicians with little or no alleviation of his complaint. Mr. Colvin had commonly but small appetite; was troubled with dyspepsia; and of a costive habit of body. Upon coming up stairs he was accustomed, as he gave at first evident demonstration, greatly to puff and blow; having, as he</p>

* Vide Case XXXIV.

expressed himself, no wind. He was troubled with lowness of spirits; his body was distended; and his nights were so disturbed, that he seldom slept three hours together. After he had been under my care but a fortnight, he came with his partner, Mr. Lowndes, a liquor-merchant at Temple-Bar, who assured me, that he thought Mr. Colvin was better than he had seen him these last eighteen years. Having inhaled six quarts of vital air mixed with thirty of atmospheric, he felt, as was ever afterwards the case, the easiest respiration—a genial glow with perspiration; vigour, and lightness; or in a word, for these are his own expressions, the sensation of indescribable health. Upon asking him, whether he perceived he was stronger? in an energetic tone of voice, he declared, “he felt five times as strong;” he added also, that his appetite was returned; and his sleep was undisturbed and continued throughout the night. He then went down stairs in the presence of Mr. Lowndes and Mr. Curtis, the son of an eminent surgeon at Chiswick, and having come quickly up stairs, he was able freely to discourse with us immediately, which Mr. Lowndes declared he had not done for years.

DYSPŒA.

Case XXXI.

Mr. A—, under Dr. Thornton, relieved. Vide Dr. Beddoes’ Considerations, Part IV. page 61.

CIRCUMSTANCES.

Letter from Dr. Thornton to Dr. Reynolds.

SIR,

In the Spring succeeding the severe Winter of 1795, which was characterized by inflammations of the chest, the patient you did me the honor to confide to my care suffered with others. The apothecary, who at that time attended, neither bled or blistered him. As the sequel to this inflammatory attack, he has been subject to dyspœa, more especially upon using the slightest exercise. Now, my dear Sir, in such unfortunate subjects, where the lungs were inflamed, I have found, upon dissection, obliterated air-cells, and, where the pleura was the seat of the inflammation, numerous adhesions. In either case little can be done or expected from medicine. Nevertheless, as the disease might be palliated, and the constitution strengthened, by the inhalation of an atmosphere of a higher standard, the trial was authorized, and the case is beautiful in itself, as throwing considerable light on the subject of respiration. Mr. A. before the inflammatory attack on his lungs, was florid, and of a clear complexion: he had once even hæmoptoe; now his cheeks are devoid of colour, and his aspect extremely bilious. Before heat was insufferable; now he enjoys a fire even in the midst of Summer. Before, his pulse, as he informs me, was accounted full; now it vibrates feebly and quickly. Whilst he inhales a super-oxygenated atmosphere, he always feels his respiration easy;

his parched hands become sensibly moist; he has a glow and tingling sensation in his fingers; and as Dr. Haighton, the celebrated lecturer on Physiology at Guy's-Hospital, noticed, his pulse is rendered both slower and considerably fuller. Immediately after this easy process, he has obligingly gone down stairs, and upon coming up again, he has breathed perfectly free, as many spectators have witnessed. In this case might not a constant inhalation of oxygen in a sphere of a higher standard produce the most certain and permanent service? but this, my dear Sir, is reserved for a more advanced state of the Pneumatic practice, when rooms are fitted up for that purpose.

I have the honor to be, &c. &c.

R. J. THORNTON.

DISPOSITION.	CIRCUMSTANCES.
Case XXXII. Rev. Mr. F—, under Dr. Beddoes, relieved. Vide Dr. Beddoes' Considerations, Part I. page 80.	This gentleman, when at Bristol Hot-wells, being much troubled with dyspnœa and mucous expectoration, used to assure me, that after inhaling diluted oxygen air, he could walk up the steep hill to Clifton, with much greater ease than at other times. He made the experiment innumerable times. This air, however, rendered him no permanent benefit, his disorder depending upon mal-confirmation.

Case XXXIII.
Mr. Yonge. His experiment. Vide Dr. Beddoes' Considerations, Part III. p. 30.

August 27, 1795.

I tried, by way of experiment, how long I could retain one inspiration of common atmospheric air, with a stop-watch before me, and found it to be 29 seconds. I then inhaled common air mixed with nearly an equal part of oxygen air, which I suppose enabled me to retain it 32 seconds. Lastly, I inhaled oxygen, such as manganese yields. This was retained, by nearly the same effort, 55 seconds.

GUSTAVUS YONGE.

XII. SPASMS OF THE DIAPHRAGM.

	CIRCUMSTANCES.
Case XXXIV. Miss S—, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page 51.	<i>Letter from Mr. Phipps, Surgeon and Oculist in ordinary to his Majesty, to Dr. Beddoes.</i> Pall-Mall, August 8, 1796. DEAR SIR, I have just received a letter containing a request of yours, that I would send a particular account of the case of a young lady who had been cured of violent spasms, by

means of oxygen air. I heartily wish it were in my power to do it with more minuteness, but I kept no journal of the case. The lady had for nearly three years prior to her inhaling the oxygen, been afflicted with spasms in her side, and indeed, through the whole extent of the diaphragm, which appeared to me the immediate seat of the complaint. For the first two years they were not constant, and only slight, very bearable, and easily removed by a few drops of laudanum. During the last year, they increased to a degree truly terrific. She was now never totally free from pain; and generally, morning and evening, the spasms became so dreadful, that I cannot find words to convey an idea of them. They would continue half an hour, one, two, three, and even six and eight hours. Laudanum, to the quantity of three hundred drops, produced no other effect than to render her perfectly delirious. Her breath was also at this time so much affected, that she could not go up or down stairs without resting every two or three steps, and panting to a degree that was frightful. In this state (during the spasm) she first breathed oxygen air by the direction of Dr. Thornton, in the proportion of about three pints to twelve or fourteen of atmospheric air, and it almost instantaneously removed the spasm. This same effect was generally obtained, and there were two and three days sometimes together during which she had no strong spasm: nor do I think, after the first week of inhaling the oxygen air, they ever returned with the same degree of violence. I found it necessary, however, to increase the quantity of oxygen to about six pints with the same proportion of atmospheric air. Thus I gave it constantly at the commencement of the spasm, and always with effect; sometimes complete, and sometimes only so far successful as to render the spasm tolerable. After about three months there was a considerable amendment, the spasms were slight and less frequent. She soon after married, and had not the least return for a year and a half; at the end of that period she had some spasmodic feelings, but they were slight, and of short duration: since (this is two years since) she has been perfectly well. These, I believe, are the leading features of the case, and I only wish I could have transmitted them to you with greater particularity. I have this morning seen the lad I mentioned in my last, as cured of asthma, he has had no return whatever, and it is now more than three months since he left off the vital air, which he inhaled for six weeks. I have only to add, that

I have the honor to be,
Your's, &c.

J. W. PHIPPS.

XIII. DYSPEPSIA, OR WEAKNESS OF THE STOMACH.

DYSPEPSIA.	CIRCUMSTANCES.
Case XXXV. Mr. Cotterel, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 65.	<i>Letter from Mr. Cotterel to Dr. Beddoes.</i> Kings-place, Westminster, Dec. 3, 1795. SIR, I was troubled with great flatulence, heartburn, want of relish to my food, lowness of spirits, coldness of the hands and feet, and had slept very ill for more than five years. Before this time I enjoyed very good health; and to be employed in my occupation for my wife and family was a delight, but now it was attended with extreme uneasiness to myself. I was under the care of Dr. Lister, Dr. Pitcairne, and other medical gentlemen of the first eminence. I had taken a great load of bark and other medicines, and during these five years I changed first from one physician and then to another, and tried what different friends recommended, but in the end I only grew worse. Having consulted Dr. Thornton, he gave me some hopes, and by his direction I inhaled the vital air, and drank three times a day water impregnated with fixed air, in which I dropt thirty drops of æther three times a day. In a fortnight I was free from my complaint, but I continued for some time the water impregnated with the fixed air, in which some salt of steel had been dissolved, and I have since occasionally chewed a warm aromatic root, and for these last two years have enjoyed very good health. I am, Sir, &c.

MATTHEW COTTEREL.

DYSPEPSIA.	CIRCUMSTANCES.
Case XXXVI. Mrs. Broomhall, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 66.	<i>Letter from Mrs. Broomhall to Dr. Beddoes.</i> Stanhope-street, Jan. 1, 1795. SIR, December 5, 1793, when I came under Dr. Thornton's care, I had a bad digestion, and a nervous headache so intolerable, to which I had been subject above three years, that I believe, had I not been cured, I must have lost my senses. I inhaled the vital air, and by Dr. Thornton's order, I took an electuary of bark and steel, three times a day, having been first prepared for that medicine. From the

first I gradually grew better, acquiring both strength and appetite, and in proportion as these improved, my head-aches were diminished. I have had no return of head-aches, or want of appetite, and enjoy at the present moment very good health.

I am, Sir, &c.

ELIZ. BROOMHAUL.

DYSPEPSIA

CIRCUMSTANCES

Case XXXVII.
Mary Hodder, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page 131.

This patient, aged 50, lives a servant to Mrs. Godfrey, No. 74, Piccadilly; has for seven years laboured under sickness at the stomach, frequent retchings, great heat and pain at the pit of the stomach, and flashings of the face after eating; drowsiness, a limy water would often flow into the mouth, emaciation, great debility, horrid dreams, often waking in excessive fright, and commonly with a dull head-ache. She would faint away after any uneasiness and fatigue, and remain for five or ten minutes like a dead person; feet and legs extremely cold, subject to flatulency, extremely costive, sight impaired; and, on account of her ill health, she was obliged to leave three places. She was turned out uncured twice from an hospital, and once from a dispensary; and had tried private practitioners without benefit. Of late the symptoms of her disorder had rather increased; when she began the inhalation of the vital air. In three weeks, by the power of this remedy, conjoined with emetics, cathartics, pearl, and steel, she became perfectly free from sickness, appetite returned, sleep was undisturbed by frightful dreams, perspiration resumed, a genial glow in the extremities, countenance became healthy, and strength so far increased, that she feels herself perfectly adequate to her present situation. The air has been left off, and the amendment continues. The quantity of air inhaled daily, was six quarts of vital air to thirty of atmospheric air.

Case XXXVIII.
Mr. Page, under Dr. Thornton, relieved. Vide Mr. Townsend's Guide to Health, Vol. I. page 277.

— Page, Esq. Member for Oxford, laboured under so dreadful an irritability of the stomach, or perhaps frequent spasm of that and the adjacent parts, that upon eating, he was almost constantly seized with vomiting, which latterly became so frequent, that nothing would stay on his stomach.

In this distressing moment, Dr. Thornton was sent for. The oxygen gas, with a certain portion of atmospheric air, was inhaled, and the balance being made on the side of oxygen, Dr. Thornton requested his patient to take some sustenance, which he had not done for many hours. Mr. Page refused it at first, as he was certain it would bring on him a renewal

of his distress. But being persuaded by Dr. Thornton and his apothecary, Mr. Wood, to make the trial, he was pleasantly surprised on suddenly experiencing the power of a new remedy, and he declared he was convinced, from the experience he had of different medicines, that no other means could have produced the same effect. He continued free from sickness as often as the oxygen air in a diluted form was administered.

DYSPEPSIA.	CIRCUMSTANCES.
<p>Case XXXIX. Mrs. Appleby, under Dr. Harrison and Dr. Darling, cured. Vide Phi- losophical Maga- zine, Number VIII. p. 420.</p>	<p>Mrs. Appleby, wife of the Rev. William Appleby, at Wooten, Lincolnshire, laboured under dyspeptic complaints upwards of twelve years. Nine physicians had tried their art, but to no purpose. The disorder seemed to gain ground, and was accompanied with violent spasms and a paralysis of her lower extremities. Dr. Harrison of Horncastle, who last attended her, desired she would try the oxygenating system; and conjointly with Dr. Darling of Glandford Bridge, it was effected in this manner. Bark and oxymuriate of potash were given, and oxygen air inhaled; and the change produced was so great, that to the surprise of the whole neighbourhood, this lady was very soon perfectly restored.</p>

XIV. AN ENLARGEMENT OF THE LIVER.

Case XL.
Mr. —, under
Dr. Thornton,
cured. Vide the
Philosophical Ma-
gazine, Number
XVII. p. 94.

Communicated by Dr. Thornton.
The butler of Colonel Ironside, who had been long resident in India, laboured for several years under a well-marked liver complaint. He had been under the care of Dr. Warren, and other physicians, without experiencing any essential advantage. Colonel Ironside, as all other means had wished him to try the vital air. He acceded to the recommendation, and the same tonics were continued; therefore I ascribe the cure to the use of the vital air, and which he has continued.

Observations by Dr. Thornton.

When animals placed in pure vital air were destroyed by so powerful a stimulus, Dr. Beddoes found the liver not liver-coloured, but of a florid red. We therefore can easily suppose it to affect this organ when given in a moderate way: and as the oxyds of mercury and the nitrous acid, which are the best remedies for this disease, act chiefly from their contained oxygen, it is probable that the vital air will hereafter be found a specific in this complaint, possessing superior advantages over both these remedies, and will supersede them, although it cannot be put up into two-ounce phials, the principal objection raised against it; for the air can now (which originated from my suggestion) be confined in barrels, and bottled off as easily as wine; and I must observe, that this patient had a barrel of vital air, containing 24 gallons, which cost him one guinea, conveyed for him to his master's seat in the country, and a tin pneumatic apparatus for inhaling the medicinal air, which stood him at the low rate of thirty shillings: which improvements, I trust, will greatly facilitate the general application of pneumatic medicine, when it will be sure to find that rank its merits entitle it to.

XV. ASCITES, OR DROPSY OF THE ABDOMEN.

	CIRCUMSTANCES.
<p>Case XLI. Sarah Kimber, under Dr. Thornton, cured. Vide Townsend's Elements, Vol. II. page 274.</p>	<p>Sarah Kimber, aged eight years, living at No. 10, Wood-street, Spa-place, Clerkenwell, with the usual symptoms of dropsy, had her belly very much distended, and upon pressure there was an evident fluctuation of water. This disorder had subsisted more than two years, and, notwithstanding the use of a variety of remedies, it went on constantly increasing, till her physician (Dr. Myers) gave up all hopes of her surviving many days; in this stage of the disease, my able friend Dr. Thornton was consulted. He began with an emetic, and the subsequent day he gave a brisk cathartic of rhubarb with a neutral salt. He applied a tight bandage of flannel about the abdomen, and ordered the strong mercurial ointment to be rubbed in each evening. He put her upon milk diet, with onion and toasted bread for supper. In a few days the emetic was repeated, and when the mouth became sore, she had for two mornings brisk saline cathartics. He then gave bark and myrrh in port wine twice a day, assisted in their operation by the inhalation of vital air. These powerful tonics were accompanied with swinging until nausea or sickness was</p>

produced, and at night she took half a grain of opium. At the end of only ten days, in consequence of this mode of treatment, the belly was diminished more than one half, her spirits revived, and her friends remarked of her, that "she skipped about the house as brisk as a bee." After fifteen days, emetics at intervals, with saline cathartics, and the mercurial ointment, were repeated; the opium pill at night, and the tight bandage were still continued. Chalybeates were then thrown in, and the emetics with cathartics were employed at more distant intervals, in consequence of which her complexion assumed the rosy blush of health; she was now able to vie with her companions in running, and the recurrence of the disease was prevented.

XVI. CHLOROSIS, OR WANT OF FEMALE RELIEF.

CIRCUMSTANCES.

Case XLII.
Miss——, under
Dr. Thornton,
cured. Vide Dr.
Beddoes' Considerations, Part III.

Letter from Mrs. Stephens to Dr. Beddoes.

Snow-Hill, August 6, 1795.

SIR,

A young lady, an acquaintance of mine, aged 20, having been two years ill, and under Dr. Carr, an eminent physician, at Northampton; but continuing in the same state, was sent on a visit to me, in order that she might obtain the opinion of some physician in London. Having had the pleasure to see the greatest benefit derived by the daughter of Sir W. D. whose case was somewhat similar, from the inhalation of the vital air, I was very anxious for her to make trial of the same means. The countenance of Miss S—— was pale in the extreme; her lips very white; her breathing short; she was incapable of the smallest exercise; so wearied was she in dressing herself, that even during this trifling exertion, she was obliged repeatedly to lie down; her appetite was very indifferent; her spirits low; she constantly complained of cold; and towards evening her legs used to swell. When we first went to Dr. Thornton's we were obliged to take a coach there and back, and even the getting out and in, and going up stairs, seemed too much for her. At the end of five days, the change in her strength was so great, that she was able to walk back near a mile and half, and in getting up stairs, instead of panting for breath at every four or five steps, she could ascend the whole flight with the greatest speed and ease. Her appetite was good; her spirits raised; her countenance shewed the signs of returning health; and her lips, cheeks, and nails, assumed a faint blush, which continued increasing, until she was in every particular

particular restored to perfect health, and could walk to and back from Dr. Thornton's, above three miles, with the utmost ease, when Miss S—, after staying with me five weeks, returned to her friends, every one was astonished at the great alteration, and indeed she hardly appeared the same person.

I am, Sir,

Your obedient humble Servant,

CAROLINE STEPHENS.

Observations on this Case by Dr. Thornton.

1. Did not the pallid countenance; the white lip and tongue; the dyspnœa when in action; the semipellucid and polished skin; the want of perspiration; the black and pearly eye; the coldness of the frame; the dyspepsia; the yellow appearance of the teeth; the lowness of spirits; the weak and quick pulse; denote a deficiency of oxygen in the system?

2. If the skin was torn (before the system was oxygenated) there would ooze from the scratch, not blood, but a yellow serum. Is not the predominance of this fluid, the cause of that sallowness of the countenance so frequently mistaken for a disease of the liver, whence these persons have the name of bilious?

CHLOROSIS.	CIRCUMSTANCES.
<p>Case XLIII. Miss Lambert under Dr. Alderson, cured. Vide Dr. Beddoes' Considerations, Part III. page 57.</p>	<p><i>Letter from Dr. Alderson, to Dr. Beddoes.</i></p> <p>Hull, June 26, 1795.</p> <p>DEAR SIR,</p> <p>I was in 1793 called to meet Dr. B—, in the case of Miss J.—, aged 17, who had been long labouring under chlorosis. As my colleague had been for some time administering a variety of very proper tonics, and being at that time persuaded that some preparation of steel would effect a cure, I advised only a different preparation of that mineral; but the change not producing the desired effect, the doctor wished some blood to be drawn from the arm, in the hopes that after the evacuation the tonics would have a better effect.—The blood was remarkably pale, and afforded but very little crassamentum indeed; no alteration took place in the system for the better; she then went to sea, and returned from her voyage somewhat better; but soon after relapsed, and the complaint being now attended with great emaciation, and an uncommon throbbing in the carotids, which upon lying down was so very troublesome as to prevent her sleeping, my assistance was again called in, and having no prejudices to overcome with her very ingenious father, I immediately proposed the inha-</p>

lation of oxygen air; the first effect of which was to take off the throbbing of the arteries, enabling her to lie down and to get quiet sleep; the other effects are concisely related by her father, in his letter to me, of which the enclosed is a copy.

I am, Sir,

Your obedient Servant,

J. ALDERSON.

Letter from Mr. Lambert to Dr. Alderson.

Hull, June 5, 1795.

SIR,

It is not necessary that I should attempt to describe after you, the nature of my daughter Elizabeth's complaint, or to enumerate the various medicines that had been administered prior to your ordering the vital air. I shall therefore only mention, that the immediate effect produced by this, was a considerable exhilaration of her spirits: in a few days the violent beating in her head greatly abated—the ends of her fingers began to assume their natural colour; and, by a steady perseverance in the use of it for about three months, together with salt of steel, from a state of the greatest debility, and an appearance the most unhealthy, she assumed her former colour, strength, and vigour. With the deepest sense of my great obligation to you,

I remain, Sir,

Your very humble Servant,

GEORGE LAMBERT.

CHLOROSIS.

CIRCUMSTANCES.

Case XLIV.

Swanwick, August 15, 1796.

Miss L.—, under

Dr. Emerson, cured.

Vide Dr. Beddoes'

Considerations,

Part IV. page 66.

Miss L. G. 19 years of age, had a suppression of the menses for more than 2 years. Her countenance was pale in the extreme, lips white, appetite impaired, general sensation of coldness, and aversion to exercise. Chalybeates, with other deobstruent and aperient medicines, were directed for her;—as these had been continued for three weeks without the desired success, she inhaled on the 20th of January, 1796, a mixture of three quarts of oxygen and 19 quarts of atmospheric air. It was administered only once a day, and in less than a week the patient was enabled to walk nearly three miles every morning for that purpose, with great ease, which she could not do at first without much fatigue; she attended afterwards with less regularity, not more than 12 doses having been inhaled in three weeks. She was sensible of its exhilarating effects, and derived a most remarkable degree of advantage from so small a number of inhalations. Her cheeks and lips acquired the ruddy glow of health,

the appetite was perfectly restored, and indolence and lassitude were succeeded by activity and spirits. She had not experienced (her own expression) so good a state of health for two or three years. The period had not, however, returned at the time she discontinued the oxygen, but she has since continued in perfect health.

R. EMERSON.

CHLOROSIS.

CIRCUMSTANCES

Case XLV.

Letter from Dr. Thornton to Dr. Beddoes.

Elizabeth Byworth, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page 67.

Duke-street, Grosvenor-square, Aug. 26, 1791

SIR,

Elizabeth Byworth, aged 17, was in service at Mr. Long's, New-Wharf, White-Friars, when from catching cold, the natural female relief forsook her, and she became subject to frequent hysterics; her countenance was bilious; she had qualmy sickness in the morning; appetite irregular; dyspnœa upon the slightest exercise, to which she felt extremely disinclined; and so great debility that she was unable to maintain her place. To these symptoms succeeded fainting, three or four times a day; a continued disturbance in the intestinal canal; spongy gums; towards evening, chilliness; but more frequently much external heat; no perspiration; and an irregular exoneration of the bowels. Notwithstanding the methods employed, this complaint remained above three years, during which time she lived with her mother, No. 6, Water-lane, Fleet-street. In getting from thence to Duke-street, she was above two hours, and was quite exhausted with fatigue. She continued as a patient five weeks, during which time she took two emetics, aloetic and steel pills, and she inhaled daily thirty quarts of atmospheric air, super-oxygenated with six quarts of vital air; at the end of less than four weeks she was able to walk here without fatigue in three quarters of an hour; she had no sickness at the stomach in the morning; could go up an ascent without stopping, or scarcely panting; the gums ceased to bleed; the appetite was constant; the lips were red; the pulse bold and regular, instead of being quick and thready; her natural perspiration returned; and the complexion was so ameliorated, that the change did not fail to be noticed by every one. She has since gone to live as servant in a family in Old-street, being now in every respect in perfect health, and adequate to the situation.

From, Sir, your's sincerely,

R. J. THORNTON.

XVII. HYSTERIA. HYSTERIC AFFECTION.

CIRCUMSTANCES.

Case XLVI.
Miss M——, under
Dr. Thornton,
cured. Vide Mr.
Townsend's Ele-
ments of Thera-
peuticks, Vol. II.
page 12.

When I was in London last winter, I had the pleasure of meeting, at the house of my ingenious friend Dr. Thornton, an amiable young lady, who spoke with rapture, of the benents she had received from the vital air. Since her arrival from Italy, which was two years ago, in the vicissitudes of this climate, she early experienced a considerable diminution of strength, appetite, and spirits. She took, in consequence, a vast quantity of bark, steel, and other tonics, under various physicians, but with no alleviation of the symptoms. When she became a patient to Dr. Thornton, she was so weak, as scarcely to be able to walk across the room; she was subject to hysteric fits, which occurred seldom less than three or four times each day; and the least angry word, or slightest contradiction, excited a flood of tears. Her feet were cold as ice; but after taking food, more especially if she used an acid, she had heat and flushings of the face, while the rest of the body remained nearly as cold as her extremities.

Having the greatest aversion to every kind of medicine, she made trial only of the vital air, except an occasional aperient draught of rhubarb and vitriolated kali in some peppermint water. In a fortnight, by the daily inhalation of vital air mixed with atmospheric, the hysteric fits returned no more: her appetite improved; her spirits rose; cold was less severely felt; and her strength was so far increased, that she was able, after a fortnight, to walk near a mile, to attend on Dr. Thornton. If at any time she left off for a few days the inhalation of the vital air, she experienced the most uncomfortable sensation of cold, and less muscular powers, with pain in her stomach; all which symptoms were removed as often as she recurred to the use of vital air. She inhaled the medicinal air during the whole of the last severe winter, continued it at intervals in the spring, used the shower-bath in the summer, and in the autumn she was in excellent health.

XVIII. QUALMS OF PREGNANCY.

	CIRCUMSTANCES.
<p>Case XLVII. Mrs. —, under Dr. Thornton, re- lieved. Vide Dr. Beddoes' Consider- ations, Part III. page 115.</p>	<p><i>Letter from Dr. Thornton to Dr. Beddoes.</i></p> <p>Duke-street, Grosvenor-square, August 6, 1795</p> <p>DEAR SIR,</p> <p>I cannot better close this year my experience respecting the effects of vital air than by the trial I have made of it in pregnancy. It had been before remarked, that pregnancy often arrests consumption, but to you first we are indebted for an attempt to explain the manner in which this effect is produced. Allow me to lay your ideas before the reader. "The fœtus has its blood oxygenated by the blood of the mother through the placenta.—During pregnancy there seems to be no provision for the reception of an unusual quantity of oxygen. On the contrary, in consequence of the impeded action of the diaphragm, less and less should be taken into the lungs. The dark colour of the blood; the aching of the teeth, and bleeding of the gums; the propensity to break out into sores, their dark appearance, and difficulty in healing; the dislike to animal food, and desire of acids and vegetables; also the black appearance of the areolæ of the breasts, peculiar to that period; and the sallowness of the countenance, seem to indicate a defect of oxygen." In the present case, most of these symptoms were strongly marked; they were accompanied with great dyspepsia and lowness of spirits. As with those under the influence of wine (the theory of which we before had occasion to consider, page 36), there was defect of appetite in the morning, with nausea and frequent inclination to vomiting. Instead of arterial, although the lady was in the vigour of life, there was venous plethora, and she complained of universal chilliness. I observed that acid fruits and vinegar were so much indulged in, as in another state of the frame must have produced great evil. This indulgence was not however previous, but subsequent to the symptoms above described, and so far from augmenting, seemed rather to lessen them.—Any smell tending to putrescency would occasion a total derangement in her constitution. Salt of vinegar and acids were very reviving, and would almost instantly stay the inclination to vomiting. In this state a violent fright produced first fainting, and then convulsive fits; these alterations would afterwards appear at uncertain intervals, and last from two to three hours. Wine, laudanum, peppermint, and brandy, seemed the most salutary remedies, either by being a stimulus adapted to the torpor of the system at that period; or else from the consent which this oc-</p>

casions with the lungs, a larger portion of vital air was in consequence imbibed by the blood flowing through that organ. As things were thus circumstanced, I thought of the vital air, and your theory authorised me to make this delicate and interesting trial. Therefore, during one of these paroxysms, peppermint-water and wine being first ineffectually administered, the room was sprinkled with vinegar, I then pressed into the lungs super-oxygenated air, and in a few minutes there was a most evident alteration for the better. This lady being so speedily recovered, the super-oxygenated air was inhaled afterwards for several days, and it seemed to bring back the frame to the natural state of health, but I chose not to persist in the use of an unknown power in so delicate a situation, unless urged by the strongest indications. The lady has since been delivered of a very fine boy.

Ever your's,

R. J. THORNTON.

XIX. PARALYSIS, OR ENTIRE LOSS OF MUSCULAR POWER.

CIRCUMSTANCES.

Case XLVIII.

Letter to Dr. Beddoes.

Captain Hemsley, SIR,
under Mr. Kentish, Captain Hemsley, ætat. 21, commanded
cured. Vide Dr. a transport in the service of Government,
Beddoes' Considerations, Part IV. which went to the West-Indies with Sir
Charles Grey's expedition. The company
page 3. consisted of seventeen men and boys, four-
teen of whom died from the ravages of the
yellow fever. In the month of June, 1795, he was attacked by the
same fever; but being ordered to England, the ship was re-manned,
and during his being ill of the fever, the ship sailed. As ships,
by steering to the north, quickly change their climate, it produced
such an effect upon him, that his existence was preserved; it could
hardly be termed more: the use of the lower limbs was entirely lost,
and the mental faculties were so much impaired, as to make his friends
despair of his recovering his powers either of body or mind. In this
state he arrived in England in August, 1795, and was under the care
of the faculty at Gosport for about six weeks. After ineffectually
using every means recommended by them, they advised his father
to take him to Bath, instead of which he put him on board a vessel,
and brought him to Sunderland. In the beginning of December, 1795,
his father brought him to Newcastle, to see if the use of the vapour
bath would render him any service: his situation, on his arrival here,
was nearly as above stated: his feet and legs were considerably
swelled from extravasated lymph, and the knees contracted

from the rigidity of the flexor tendons: these parts felt below the ordinary temperature of his body, and were very insensible to the touch. Mr. Abbs, with whom I have the pleasure to be connected in business, agreed with me in thinking that the vapour bath might be of use, at least in procuring a relaxation of the rigid tendons; accordingly we ordered him to use the bath three times a week: this he continued for a month, from which he found considerable relief; the swellings of the feet disappearing, and the tendons relaxing, so as to allow every species of motion; but still there was no recovery of voluntary motion, nor any additional power. We gave him calomel in small doses; but so small a quantity affected his mouth, that he received little or no benefit from its use. The bath having performed its duty, by increasing the activity of the absorbents, and restoring flexibility to the joints, not being attended with any further beneficial effects, was desisted from, and the use of tonics, both general and local, were had recourse to; partial bathing to the feet, stimulant liniments, and electricity, wine, bark, and steel; these had an apparent good effect for some days, and then their power seemed to cease; we, therefore, thought of giving the oxygen gas. This being mentioned to a medical friend (Dr. Ramsay); he coincided in the opinion; accordingly, on the 1st of February, 1796, he took two quarts of oxygen, diluted with eighteen of atmospheric air. After drawing in half a dozen inspirations, he found a glow spreading over the whole surface of the lungs, and said he felt as if going to break into a sweat upon the neck and chest. As that part of the nervous system which retained its power, seemed possessed of great mobility, might not this sensation arise from sympathy of the external with the internal surface, as we sometimes observe such consent between the stomach and the skin? The sense of heat continued for about a quarter of an hour, and he felt nothing more from this dose: it was repeated every morning, with his expressing nearly the same sensations. On the fourth morning his urine was much loaded, and deposited a copious sediment, of a reddish flaky matter, resembling brick dust. Sixth day; says he thinks his legs lighter; that is, in lifting up either of his legs, which he does by putting both his hands round his thigh above the knee, he uses less exertion, therefore we hope he has more power of motion in the leg: he has for some years been subject to a scorbutic eruption upon his face, which since his taking the air is rather better, and appears drying with brawny scales. Eighth day, describes the sensation he feels from the circulation of the blood in his leg, which he says sometimes stops suddenly, and then rushes on again; he describes the circulation so accurately, that the internal coats of the vessels appear to give him the sensations which he expresses. Does not this plainly shew that the blood in its passage through the lungs, under the influence of a fully oxygenated atmosphere, receives an increased degree of it, which it slowly unfolds to the other parts of the system

The attendants about him observe a great change in his conduct; for though a sailor, he seemed to want the fortitude that class of men are generally possessed of; nor had he that sort of jocularly, but at present his spirits are much better. Tenth day, the glow continues longer, nearly half an hour; the circulating sensation continues, and is much more frequent; his spirits increase, and he says he feels such a change in himself that he begins to have hopes of recovery. Fourteenth day, he gathers strength of body, and his mind partakes, from the same cause, a greater degree of energy; his memory is much more perfect, and his answers are given with such a degree of quickness, in comparison with his manner previous to the taking the air, that he scarce appears the same individual. Sixteenth day, the urine has ceased to deposit, and as his strength encreases, the sympathetic effect upon the skin gradually decreases; he is now enabled to stand with the assistance of crutches and his back supported against the wall. From being so long (seven months) accustomed to lie in bed, and sit on low seats, when standing erect, his head swims like a man upon a precipice, un-used to such situations. Eighteenth day, his strength increases in his limbs, and his vertigo not so considerable; can take a few steps sideways upon his crutches, and his back against the wall. Twentieth day, recovers daily; ventures a few steps from the wall upon his crutches; when his stockings are off, his toes are perceived to have a weak voluntary motion; his face continues the same, and his spirits remain good. Twenty-third day, continues to improve; can get off his chair alone, and walks about his room on crutches; expresses a great desire to be allowed to come down stairs, in which he is indulged; it is the first time since he has been here, which is between two and three months, seems highly delighted with the change, as he expresses himself, he feels he gets better every hour; the air in the same quantity (2 quarts to 18) is still continued. Twenty-eighth day, the weather being fine, he is allowed to walk in the garden; the muscular fibre, which was very much relaxed, has greatly recovered its tone, particularly the calves of the legs, which were so soft as more to resemble bags of oil than muscular fibres, are now possessed of that tension which bespeaks health and strength. March 3d, continues to improve, except that his feet and legs are a little stuffed in an evening; as the vapour bath, previous to the use of the air, took away the œdema from the legs, he is to use it again. March 6th. Since he was in the bath his legs have not been so much swelled; in every respect continues to improve; the pulse has not been mentioned in this case, though it was attended to, but in a chronic case it seemed a little necessary; it will be sufficient to remark, that at the time of beginning the use of the oxygen, his pulse was about 100 strokes in a minute, low, and weak; that immediately upon his taking the first dose of gas, his pulse beat from 8 to 10. strokes in a minute slower, and appeared a little more expanded; in the course of

an hour or two it returned to the usual standard, with this difference, that as he gathers strength, the immediate effect is not so great, and that now the usual state of the pulse, instead of being from 100 to 110, is only from 80 to 90. March 10. Continues to get better; can now walk for some time in the garden upon his crutch. March 15. He now uses a great deal more exercise; complains of a numbness of the arm of the right hand. On investigation, this appears to have arisen from his remaining longer than usual upon his crutches, which were not sufficiently stuffed to prevent the compression upon the brachial nerve, and the large vessels of the arm. March 20. From removing the cause of his numbness, the effect has ceased; continues the air, which is now increased to three quarts. April 9. No bad symptoms arising from the continued use of the air, and as at present he appears stationary, it is thought advisable to give the same dose twice a day. April 20. The increased dose seems to have been of considerable use; has made more progress; he can now walk with the assistance of two sticks; is in great spirits; entertains no doubt of getting well. May 6. Is now so well, that we have advised his father, who lives by the sea, to take him home for the benefit of sea-bathing, which, we have no doubt will perfectly restore him.

Extract of a letter (inclosing the preceding Case) from Mr. Kentish.

Newcastle, June 6, 1796.

SIR,

I likewise inclose a letter from my friend Dr. Ramsay, of whose attendance and advice I profited during the whole of the case. I wished his testimony as well as my own, for we are sometimes led to be too partial, where we are anxious for success. This first essay has induced the faculty of the Infirmary here to order an apparatus; and as my partner (Mr. Abbs) is the senior surgeon, I shall have an opportunity of seeing its effects in surgical cases. Several, related both in the 1st, 2d, and 3d Parts of your Considerations, would induce us to hope for considerable aid from it. When I am further acquainted with the result of Captain Hemley's case, I will inform you of it, when I hope to have some more observations to communicate. I shall hope to hear of your receipt of this; and I have the honor to be.

Sir, your obedient humble servant,

J. KENTISH.

Letter from Dr. Ramsay to Dr. Beddoes.

Newcastle-upon-Tyne, June 10, 1796.

SIR,

It gives me pleasure to have an opportunity of adding my testimony to Mr. Kentish's, of the efficacy of oxygen gas, in the case of Captain Hemsly.

I saw the patient after the fruitless administration of the remedies enumerated, and was asked whether he appeared a proper subject for a first trial of Pneumatic Medicine here. Anxious for a trial under less unfavourable circumstances, I hesitated for a while. Hopeless, however, as the patient's situation seemed to be, I at length approved of the attempt, as failure could not lessen my confidence in its general utility; and aware that success in this instance would to others afford proof indubitable of its efficacy.

The case, as drawn up by Mr. K. presents a faithful and accurate statement of facts. The conjunction of cause and effect, that is, the administration of the remedy and amendment, has seldom appeared more distinctly in the employment of any medicine in any disease than in the present instance. The zeal which Mr. K. has uniformly shewn for the advancement of medicine, and his readiness in adopting every means that promise to promote that end, entitle him to the thanks of every friend to science.

I am, Sir,

Your very humble servant,

JOHN RAMSAY.

FATALITY.

CIRCUMSTANCES.

Case, XLIX.

Mr. Danby, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 41.

Letter from Mr. Danby to Dr. Beddoes.

Upper John-street, July 19, 1795.

SIR,

I had the honor of receiving your letter, in which you request my case, and an account of the effects that the vital air had on me. I have accordingly drawn up the narrative which I enclose.

I went the latter end of July, 1794, in tolerable health to ———. Not designing to stay there long, I took up my abode at an inn in the town. I ordered, as was my custom at these places, port wine after dinner and supper; I observed the wine had a peculiar sweet and soft flavour, which was very unusual and agreeable, but I by no means drank of it to excess. On the third day after my arrival I was seized with tremors, and

having taken up a pen to write out some music, to my great alarm, I found I could not accomplish it. The friend who was with me, complained at the same time of a most violent bowel complaint, with great griping and copious evacuations. I was soon after seized with spasms, and lost the use of both hands and feet. I proceeded on to Lymington, and having consulted a physician there, was ordered bark and sea bathing. I went then to the Isle of Wight, and attempted to bathe once, and immediately perceived a great increase of my disease. I therefore hastened back to town, and as soon as Dr. Rowley heard that I was in a most deplorable state, he voluntarily came to offer me his services, and with the greatest kindness visited me both in town and country. But notwithstanding those remedies, which I have not the smallest doubt were the most promising of the pharmacopœia, yet my disorder kept on advancing, and as I had been taking drugs for five months without benefit, I grew very anxious to make trial of the vital air, which had been of the greatest service to some of my friends. But I did not choose to enter into any new scheme, without first consulting my friend Dr. Rowley, who, so far from objecting to it, wished me by all means to make trial of the vital air. I waited therefore upon Dr. Thornton. It was the beginning of last December. My hands were pendulous, so that I was obliged to be fed, dressed, and undressed, like a child; being quite helpless, having no use of my limbs, I was also obliged to be carried from place to place; my countenance, as well as I can express it, was of a black yellow; my appetite gone; and my nights truly dreadful. Counting the hours as they passed, I repeatedly prayed for morning, which was no sooner come, than I hurried from my place, as I called it, of torment. You will scarce credit the assertion. A week had not passed from the time of my first inhaling the vital air, before my appetite returned, and my nights were rendered exceedingly comfortable and refreshing; my spirits, as you might expect, were very great; my appetite the same; and my wife and family observed that my countenance was considerably mended. Before the month was out, the motion of my hands was so far restored, that I could compose catches and glees, and in six weeks I began to employ my crutches. My general health is at the present time fully established, I walk about without crutches, and Dr. Rowley says, "I ail nothing now but weakness, the consequence of previous indisposition."

I have the honor to be, &c.

JOHN DANBY.

PARALYSIS	CIRCUMSTANCES.
<p>Case L. Mr. Howison, under Dr. Thornton, cured. Vide Philosophical Magazine, Number XVI. page 429.</p>	<p><i>Communicated by Dr. Thornton.</i></p> <p>Mr. Howison, who dissects for Mr. Cruickshank and Mr. Wilson, eminent teachers in the school of the late Dr. Hunter, had a paralytic affection of the right hand, which deprived him of its motion, and it felt to the other hand always remarkably cold. The paralysis seemed chiefly seated in the muscle of the thumb. I advised him the trial of electricity; and we observed, as well as those who accompanied him, that the electric spark did not fly with a crackling noise to the paralytic muscles. Trying a piece of dead meat, we found the same phenomenon. We then had recourse to inhalation of vital air mixed with atmospheric. The muscle, now receiving oxygenated blood, afterwards caught the electric spark very readily, and a genial warmth was diffused throughout the paralytic hand. This was not a solitary observation, but constantly the case, and it seems to me very forcibly to prove the animating principle derived from the oxygen of the air to the muscular fibre; a principle not, as represented by Mayow, the most subtle, spiritual, and æthereal, but one that can be made obvious to our senses in the form of air, adhering to the calces of metals, and capable now of being conceived even by the most gross understandings.</p> <p>The patient, I am happy to add, by this combination of external and internal stimulants, is completely restored, and has continued now many months perfectly well:</p>

XX. ATONIA, OR EXTREME NERVOUS AND MUSCULAR DEBILITY.

CIRCUMSTANCES.

<p>Case LI. Mrs. Roberts, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part IV. page 65.</p>	<p><i>Letter from Dr. Thornton to Dr. Beddoes.</i> Duke street, Grosvenor-square, July 4, 1796.</p> <p>SIR,</p> <p>Mrs. Roberts, aged 50, who lives at No. 43, Piccadilly, was more than twelve years ill. She had been successively under the most eminent physicians, first under Dr. Pinkston, then under Dr. Cadogan, next a full year under the celebrated Dr. Cheston of Gloucester, from him she passed under the hands of Dr. Farmer, of that city, who attended for two years, and she was next under a distinguished practitioner of Bath, and so she went from one able practitioner to another;</p>
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she was at last so reduced, that she was not only confined to her room, but could scarce get from her bed to an easy chair, which was placed in it. Dr. Merryman now attended her. Her long illness had already cost her above 300 pounds. Being called in, I premised a mild aperient, and afterwards ordered bark and lime-water, and gave Mrs. Roberts the vital air. At the time of inhalation this lady felt greatly relieved; the yellowness of her complexion soon wore off; she had a glow of warmth; her appetite and perspiration were established; and so sudden was the amendment, that in less than a month she was restored to perfect health, and has continued so now above three years.

I am, dear Sir, your's, ever,

R. J. THORNTON.

P. S. The quantity of vital air given was six quarts to thirty of atmospheric air.

ATONIA.	CIRCUMSTANCES.
<p>Case LII. Mrs. Robinson, under Dr. Thornton, cured. <i>Vide Philosophical Magazine, Number XI. page 299.</i></p>	<p><i>Letter to Dr. Thornton.</i></p> <p style="text-align: right;">Dulwich Common.</p> <p>DEAR SIR,</p> <p>I return you many thanks for your kind attentions to Mrs. R. Your method of treatment, under Providence, has certainly performed a wonderful cure. My wife had not inhaled the air three times before I perceived a very great alteration, both in regard to appetite and spirits; her strength, in a week, was also so much restored that she could with ease walk five miles, when before it was quite a fatigue to walk one. I can with pleasure likewise add, that what alarmed us both—the coldness of her extremities, and blackness under the finger-nails—are both entirely removed, and her nails now appear healthy. As my wife has not enjoyed such good health for several years as she has experienced these last six months, Mrs. R. unites with me in grateful acknowledgements to you;</p> <p>And I remain, dear Sir, your's respectfully,</p> <p style="text-align: right;">M. ROBINSON.</p>

Observations by Dr. Thornton.

This lady, residing in a country seat, which has a delightful garden, and a good deal of ground attached to it, in an open situation, could not be supposed to want vital air in the blood. Such, however, appeared to be the fact. In such cases I find by the sphygmometer, that the blood is in fault, attracting but slowly into its bosom the vital principle. But as even the most apparently incombustible bodies readily deflagrate in pure oxygen air,

as steel, &c. the same phenomenon might be expected in the human frame; and in the present instance we see that this was actually performed. The good, however, of a temporary inhalation of a super-oxygenated air would have been lost, unless the blood had been altered. Steel was therefore enjoined, together with what is styled the phlogistic regimen; and the event exactly corresponded with my expectations—the radical defect was obviated, the attractive power in the blood was improved, and the blood, coming into contact with a super-oxygenated atmosphere, readily imbibed a large proportion of vital air. The blackness under the finger-nails in consequence soon disappeared, the appetite became quickened, the spirits were increased, and the blood freely passing from the centre to the circumference, and from the circumference back again to the heart, the phlogistic particles decomposing the vital air in the blood in its passage, hence the extremities, and the whole body, became permanently warm.

XXI. MELANCHOLIA, OR GREAT DEPRESSION OF SPIRITS.

	CIRCUMSTANCES.
<p>Case LIII. Mr. Russel, cured. Vide Mr. Townsend's Guide to Health, Vol. I. page 292.</p>	<p>Mr. Russel, an engraver, who lives in Constitution Row, Gray's-Inn-lane, had been many years in so desponding a state, that latterly he could not even bear the innocent mirth of his numerous family. He was nearly incapacitated from his employment, and as he had tried bark, steel, and other tonic medicines, without benefit, he entertained but little expectation of recovery.</p> <p>He had a cough in the morning, was of a very costive habit, had frequent and violent head-aches, and passed, for the most part, restless nights, or, when he slept, he was troubled with frightful dreams. Being emaciated, and looking very sallow, he was conceived by every one to be in a deep decline.</p> <p>Dr. Thornton, with that propriety which pervades his whole practice, gave him first an emetic, then a gentle cathartic, and after that, he united all the tonic powers to recover him; as, the inhalation of oxygen air, diluted with a portion of atmospheric air; bark, with a tincture of the same; and columbo root; a more generous diet; exercise; and the amusement of company. He cautioned him, for the easy passage of food (as the motion of the stomach is from left to right) always to lie on his right side.</p> <p>He gave him occasionally an emetic or cathartic, and, under such judicious treatment, he was in a very short time restored to health.</p>

A letter from Mr. Russel to Dr. Beddoes.

Constitution-Row, Gray's-Inn Road, Aug. 7, 1795.

SIR,

The Rev. Mr. Townsend's account of my case is perfectly correct, and expressive of my situation. Wherever I go, all who know me testify the greatest surprise at seeing me so recovered. Since which time (nearly two years) I have continued in excellent health, having had no return of my former or any other complaint.

I am, Sir,

Your obedient Servant,

JOHN RUSSEL.

Observations on this Case by the Rev. Mr. Townsend.

The symptoms of melancholia are:

1. *Pulse slow, small, weak, and the balance of the sanguiferous system on the side of the veins.* See Cullen's First Lines, § 1589. This proves that the vital energy of the heart is so much diminished, as not to balance the natural elasticity of the arteries. Hence they contract more forcibly than the heart, and protrude the blood into the veins faster than it can return. The slowness, smallness, and weakness of the pulse seem to be proportioned to the diminution of oxygen. When this fails, pulsation ceases; and the blood being collected wholly in the veins, the arteries are altogether empty.

2. *Respiration slow.* The respiration seems to be governed by the pulse, as I have already had occasion to explain, when stating the consent between the heart and lungs. It certainly bears proportion to the demand for oxygen, as may be observed in dogs, who have consumed more than their usual quantity when in pursuit of game. The more pure the air, the slower is the respiration; but in proportion as the air is vitiated, either by substances, which are destitute of oxygen, or by those which greedily combine with it, the more laborious is the respiration. This may be proved by the breathing of some asthmatic patients, and their cure by well oxygenated air. This we observed in my account of a bilious autumnal fever, to which I must refer the student. Since then the respiration in melancholia is slow, it is evident that the demand in the system is small. If more were demanded, more would be supplied, and respiration would be quickened.

3. *Paleness.* This universally is a symptom of debility, and proves that the balance of the sanguiferous system is on the side of the veins, or, in other words, that the vital energy of the heart is much diminished. This may be clearly proved by the paleness of syncope and death.

4. *Perspiration* and all the *secretions* much diminished. These effects naturally follow the weakened energy of the heart, but they do not altogether depend upon that cause, for the secretions are promoted by oxygen, and suffer loss by its deficiency.

5. *Coldness of the extremities.* That vital heat depends on oxygen, is put beyond a doubt by the experiments of Drs. Crawford, Beddoes, and Thornton, which prove that it bears proportion to the quantity of this received into the lungs. Heat, however, is not generated merely in the lungs, but throughout the system, wherever there is either muscular motion or animal secretion. The pulsation of the arteries, and the oscillatory motion of the extreme vessels, with the secretions, being, as already stated, all diminished, the vital heat must consequently be diminished to the same degree, and this diminution will be therefore most perceptible in the extremities, where the quantity of blood is least and its circulation slowest.

6. *Digestion much impaired.* This effect seems to arise from the diminution of the vital heat, for by the experiments of John Hunter on various animals which sleep through the winter, it appears, that the digestive process is quickened by heat, and checked, or totally suppressed, by cold. But if the student recollects what has been delivered in the first volume of this work, on respiration and digestion, he will be, I trust, inclined to think that digestion is promoted by the inspiration of oxygen, and impeded by vitiated air received into the lungs. Digestion, however, is not produced by either heat or oxygen, but by the gastric juice. We have reason, therefore, to conclude, that for want of oxygen, the gastric juice is either deficient in quantity, as we may be the more inclined to think, when we consider, that all the secretions are diminished, or vitiated in quality, as may be readily conceived, when we reflect, what changes in the whole system are produced by air and heat.

7. *Loss of appetite.* This naturally follows from the deficiency of gastric juice. But when the appetite, instead of being impaired, is exceedingly voracious, this may arise from the stimulus of indigested sordes.

8. *Costiveness.* This likewise may be attributed to want of oxygen, for when Dr. Thornton, as he informs me, made his dyspeptic patients breathe super-oxygenated air, they not only acquired appetite and spirits, but became more regular in their bowels. Oxygen increases the secretions in general, and therefore may increase the quantity of bile, which is the natural cathartic of the body, and, at the same time, giving tone and vigour to the secreting vessels, it is probable that it may improve the quality of the secreted fluid. But independently on this, we may observe, that the perspiration being diminished, the determination is naturally increased to the internal surface, where, at the same time, the glands being much relaxed, a superabundant quantity of mucus, of viscid mucus, is collected, so as to separate between the bile and the animated fibre, and thereby pre-

vent the operation of that natural cathartic. It is not, however, an universal symptom, or constantly present in melancholic patients.

9. *Spirits depressed.* I have already had occasion to speak of well oxygenated air as raising the spirits, and have related the case of Mr. Russel; but since that period we are favoured with many still more interesting cases, in which the same effect is frequently remarked. The case I chiefly refer to is, that of Mr. Atwood, communicated to Dr. Beddoes, and by him presented to the public in the second edition of his inestimable work, entitled, *Considerations on the Medical Use and on the Production of Factitious Airs*; printed for Johnson, in St. Paul's church-yard. As I very often saw Mr. Atwood during the progress of his cure, I feel highly interested in his journal, where I am happy to observe the same energetic expressions, which I heard him utter, whilst he was under the care of Dr. Thornton. If then the spirits are elated by a plentiful supply of oxygen, are we not warranted in our conclusion, that depression of spirits may be caused by its deficiency? Should we enquire how it happens, that the lungs do not derive a proper supply from atmospheric air, I might simply appeal to facts, leaving others to assign the cause and to account for this effect. But I shall rather make the attempt myself, and at the same time remind the student of the hints, which I ventured to throw out in the first volume of my work.

Every process in nature seems to depend on either attraction or repulsion.

Of attraction, we distinguish various kinds; the attraction of gravitation; magnetic attraction; the attraction of electricity; and chemical attraction. But besides these we observe another, which may be called vital attraction. On this depends the growth of the living fibre.

Vegetables attract their nutriment, both by their leaves and by their roots, which in extent are proportioned to each other. Animals go in search of food; but after they have swallowed and the stomach has digested this, the lacteals make their selection, and absorb such parts as are best suited to nutrition. In them the absorbents of the alimentary canal, at the different periods of their growth, and the pulmonary air vessels bear proportion to each other, and I have already stated a relative proportion between the oxygen attracted by the lungs, and the quantity of food digested by the stomach.

If, therefore, the process of digestion is impeded, the attraction for oxygen and its separation from azot, with which it is combined or blended, according to Jacquin, in atmospheric air, will be diminished. But when the air is overcharged with oxygen, the quantity separated by the lungs in respiration, even in the most unfavourable circumstances, will be increased.

Thus we see in the burning of a culinary fire, when it is almost extinguished; let the atmospheric air be overcharged with oxygen, or give it nitre, and the effect immediately produced will be rapid combustion with vehement heat and vivid flame; or supposing the air to have only its usual proportion of oxygen, let more combustible matter, such as sulphur, ether, ardent spirits, or even oil, be added to the fuel, and the effect will be the same. In some cases it may be sufficient merely to blow away the dust which separates between the combustibles and oxygen.

These attractions and combinations are governed by the laws of relative affinity, some of which, accurately determined by the sagacious and most laborious Kirwan, he has been so fortunate as to express by numbers.

In accounting for the costiveness, I mentioned my opinion, that it might arise from viscid mucus in the alimentary canal. This cause, as I am inclined to think, will at the same time prevent nutrition, and lessen, in the system, the demand for oxygen, and then we must not wonder that the lamp should emit a feeble light. With a plentiful supply of oxygen and hydrogen, the flame is bright; but a single drop of water floating on the surface of the melted wax, will be sufficient to cut off the communication and prevent their combination, and such appears to me the effect of viscid mucus in the alimentary canal.

From all that has been suggested, I am inclined to think with Dr. Cullen, that in melancholia there is torpor in the motion of the nervous power both with respect to sensation and volition (See his first lines, § 1589); and this, in my opinion, seems to depend on viscid mucus lining the intestines; for no sooner is it, by a judicious treatment, cleared away, than vital heat increases, the pulse acquires strength, torpor is relieved, and the spirits rise.

This perfectly agrees with what I have stated respecting the remote causes of melancholia, all which relax the glands of the intestines, and produce accumulation of their mucus. And upon this principle, Hoffmann in melancholia approves of antimonials, *Quod si enim tenaces, visci et biliosi in duodeno stabant humores vomitu evocandi sunt; flores antimonii egregium pollicentur fructum.* Vol. III. p. 261.

MELANCHOLIA

CIRCUMSTANCES.

Case LIV.

Dr. Thornton to the Editor.

Mr. Blundel, under Dr. Thornton, cured. Vide Philosophical Magazine, Number XI. page 300.

SIR

Mr. Blundel, æt. 49, a wholesale linen-draper on Holborn Hill, was subject to melancholia above thirty years; that is, he had frequent depression of spirits, without any assignable cause; and this lowness was not casual, but would remain for months with great languor, and

was accompanied frequently with a distaste of every thing before agreeable. Mr. Blundel's only relief was a journey into the country, which he had been accustomed to take every year. Having two very eminent physicians as half-brothers, the celebrated chemist Dr. Bryan Higgins, and Dr. Haighton physician to the Eastern Dispensary, the most eminent physiologist of this country, every thing that the art of medicine could do had been employed, but without any material advantage. Mr. Blundel wished, therefore, to make trial of the vital air; and he inhaled it at first under the management of a self-taught genius, his neighbour Mr. Varley, of Hatton-House, Hatton-Garden, and found at that time "an increase of strength" and "his spirits mended." But what struck him most was, "an issue which used to discharge was, since his commencing the air, completely dried up." Another thing he remarked, "that after walking he had varicose tumours in the veins of his legs; but that these did not appear, even after a long walk, since he had inhaled the vital air." I will select a few more observations, as made by Mr. Blundel.

"September 20. Spirits much enlivened after taking the vital air.

"September 22. The same good sensations have continued, although I did not take the air yesterday.

"September 23. Found my mind tranquillized, and somewhat elated towards evening; and when I awoke the next morning, perceived a general glow over the body; the feet, which used before to be always cold, were comfortably warm; the fingers glowed to their extremities, and I could clasp them with firmness; before, they would feel cold and numbed, and I was obliged to rub them before I could close them. All my family observe that my countenance looks less sallow.

"September 25. Spirits continued throughout the day very good. Sleep grateful.

"September 26. The same to-day.

"September 27. The same observations to-day."

I should mention, that when Mr. Blundel applied to me, I desired him to continue the air with Mr. Varley, and ordered a seton in the neck, as the issue was dried up. I directed also bark, columbo, and prepared kali, to correct acidity and brace the stomach, as also to render the blood more attractive of oxygen, and the body was kept regular with aloetic pills; and this plan speedily produced the blessing of sound health, which has continued now upwards of fifteen months, without any disagreeable nervous sensations, and without a single excursion being made into the country.

I am, Sir, &c.

J. R. THORNTON.

P. S. In the case of Mr. Russel, which was melancholia, recorded by Dr. Boddocks, the cure was effected without a seton; how much are we therefore to attribute to this application in the

present instance? The drying up of the issue by the vital air, when employed alone, did it not denote, from the absorption of this principle, an increased energy of the absorbents? I have before noticed, that where serum was discharged, that has happened; but when matter is secreted, there is on the contrary a more abundant discharge, or the serum is converted into laudable pus. In the case of Mrs. Fixsen, St. Anne's-Street, Westminster, an issue which could not be made to discharge, began immediately to pour out matter, upon the commencement of the inhalation of the oxygen air. The varicose veins disappearing was a strong mark of increased energy in the circulating vessels. The numbness of the fingers going off, shewed increased action remote from the heart; the glow, the increase of spirits, all declare in marked expressions the influence of vital air; and what makes me the more inclined to this opinion is, that country air before used to afford the only relief.

XXII. SCORBUTIC ERUPTIONS OF THE FACE, ARMS, AND BODY.

CIRCUMSTANCES.

Case LV.

Mr. Cummins, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part III. page 93.

Letter from Mr. Cummins to Dr. Beddoes.

Islington, August 1, 1795.

SIR,

For more than two years the whole surface of my face was covered over with eruptions. To describe my real state would be as disgusting for you to hear, as it was disagreeable for me to bear. I had tried different purifiers of the blood, but the humour in my face continued the same. Hearing that the vital air altered the state of the blood, about nine months ago I placed myself under Dr. Thornton's care, and began the inhalation of the vital air. In less than ten days I felt a very great itching, which I do not remember to have had before. The itching, however, subsided, and my face was quite cleared in about a month. This state continued four months, when I had a relapse, but it soon gave way to medicine, and my face has continued since perfectly clear, or only here and there a pimple appears.

I am, Sir,

Your obedient servant,

JOHN CUMMINS.

SCORBUTIC, &c.	CIRCUMSTANCES.
<p>Case LVI. Elizabeth Franklin, under Dr. Thornton, cured. Vide Dr. Beddoes' Con- siderations, Part V. page 138.</p>	<p><i>Letter to Dr. Beddoes from Dr. Thornton.</i></p> <p>DEAR SIR,</p> <p>Elizabeth Franklin, aged 19, naturally of a very strong constitution; with that want of prudence so frequently observed with those who trust too much to this circumstance, after a hard day's labour, being very dry and hot, drank a large quantity of cold water; which immediately produced so violent an head-ache, that she was obliged to go to bed. The next day there appeared an efflorescence on the skin, which soon ended in a scurfy eruption on the arms. It had progressively encreased, it is now five years; and at length incapacitated her from service, and she became a burthen on her family. She had been under Mr. Dundas's care at Richmond eleven months, but without benefit; having before tried a variety of remedies. Observing the great amendment of her neighbour, Richard Major, whose case I have before related, she was induced to apply to me. I ordered her a lotion of nitre and vinegar, which Mr. Patterson, conducted by your observations upon sea-scurvy, found to be a specific in that disease. I gave her vital air to inhale, as a purifier of the blood, in the proportion of six quarts to thirty of atmospheric; and I diffused a greater energy of circulation in the capillary vessels by means of myrrh, bark, and steel, having first cleared the primæ viæ. The effect of the acetum nitrosum, or solution of vinegar in the nitrous acid, was the encreasing the eruption, occasioning acute pain, and rendering the parts very florid. It was, however, persisted in, and, after a fortnight, the benefit from this application became very conspicuous. The vital air, at the time of inhalation, always diffused a glow, encreased the number of the pulse, and produced perspiration. The other remedies tended to keep up this effect; and, after a month, the arms, which before bled upon the least pressure, were in a fit state to bear the flesh brush, which has been ordered; and the surface, after six weeks, only shews the great extent and malignity of the former afflicting disorder; and the young woman is restored as an useful member to the community, being now fit for washing, and any other hard services.</p>

Ever your's,

R. I. THORNTON.

SCORBUTIC, &c.

Case I.VII.
Jane Finlayson, under Dr. Thornton cured. Vide Dr. Beddoes' Considerations, Part V. page 141.

CIRCUMSTANCES.

Letter from Dr. Thornton to Dr. Beddoes.

Duke-street, Grosvenor-square, Aug. 23, 1796.

DEAR SIR,

Jane Finlayson, aged 7, living at No. 4, Carrier-street, Bloomsbury, had the small pox five years ago; since which period she has been afflicted with a dreadful scorbutic humour, covering both legs, the shoulders, and the arms; which either encrusted, forming scales, or ouzed out a thin, serous discharge, discolouring the linen. She would often awake in the night; when, probably from extreme itching, she would tear the humour, converting it to a sight truly terrific and disgusting. This she would sometimes do, even in the day. Her mother first applied to the Gerrard-street Dispensary; and she took pills and aperient powders for six weeks, under the care of Dr. Jackson, without benefit. Her mother then took her to Mrs. Spilsbury, and she continued taking her drops for nine months; but this boasted remedy was equally ineffectual. She now went into St. George's Hospital, and fell under the care of Mr. Keate; who employed the unguentum hydrargyri nitrati outwardly, with mercurial pills every night, and an aperient powder every third morning; and these were persisted in for three months; but they produced only a slight degree of benefit, and in a few days after she was taken from the Hospital, the disease appeared as bad as ever. Her mother then, from a very prevalent opinion, judged her only hope was from her breathing her native air, and she accordingly took her over to Ireland; but neither the journey, voyage, nor native air, proving of service, she applied to Dr. Frazier, of Dublin, under whose care she continued six months. He employed tar ointment, and a lotion chiefly consisting of a weak lime water: but, as the case seemed to defy all art, the mother thought fit to return with her child, rather worse, than mended, seven months ago. Mr. Ogle, an apothecary in Great Russel-street, at this time refused to do any thing for her, telling her mother, "he could not be of any service, and it was best to leave her disorder to nature." This was the candid opinion of some other gentlemen of the faculty; except that one recommended tar ointment, and it was tried. The disorder however getting a-head, the poor child was for six weeks wholly incapacitated from using the slightest exercise; not being able to stand upon her legs, the humour had spread so around the knees. She was therefore brought to me in arms, and she inhaled immediately six quarts of vital air mixed with twenty of common air; and such is the fact, in two days' time, she was able to walk here, above a mile and a half; her spirits were elated; her complexion was cleared; the wounds had thrown off large scales, shewing a glossy red skin underneath; in a week the progress was such, that some large patches had already disappeared;—in a fortnight the humour on the legs and

thighs was in many places hardened, and had scurfed off;—and in three weeks on the back and arms there remained only the signs of previous disease;—and it is now twenty days, and the legs, thighs, the back, and arms, shew a truly natural and healthy appearance. The girl took all this time three or four doses of aperients, and no other medicine.

From, dear Sir, your's ever,

R. J. THORNTON.

Letter from Dr. Bubbington to Dr. Thornton.

Basinghall-street, Sept. 16, 1796.

DEAR SIR,

Mrs. Finlayson called upon me yesterday with her little girl, and brought me your letter. My recollection does not enable me, having seen the child but once, to contrast minutely the former appearance of the eruption with the subjacent parts that are now exhibited. I am satisfied, however, that there is a material alteration for the better. The inflammation, I see, has entirely subsided; there is no longer any serous discharge, which, the mother says, was at one time very abundant; and, though there is still a roughness, the superficial scaly incrustation is scarcely now to be perceived. Wishing you equal success in all parts of your professional pursuits, I remain,

Dear Sir,

Very sincerely your's

WM. BABBINGTON.

XXIII. THE TRUE LEPROSY.

CIRCUMSTANCES.

Case LVIII.

Amaro Fernandez, under Dr. Thornton, cured. Vide Dr. Beddoes' Considerations, Part V. page 147.

Letter to Dr. Beddoes.

London, October 30, 1796.

SIR,

Don Amaro Fernandez, aged 26, has been afflicted with leprosy above seven years. He is a native of the Canary Islands, where we find that disease prevalent, chiefly among the common people, whose food consists almost entirely in salt fish, ill cured, and eaten in a state of putrid fermentation. This disease resembles much elephantiasis, differing perhaps from it only in the extent and urgency of the symptoms. It is generally deemed incurable, and terminates in rendering the unfortunate sufferer a miserable object; depriving him, by its corrosive nature, of nose, ears, palate, and eating away also other parts of the body. It increases by degrees, and sometimes gives a glimmering of hope; but the expectation always proves delusive. I will attempt to trace the dreadful progress of symptoms; and shall commence by observing that in the year 1789, an eruption broke out on his face, arms, thighs, and legs, which ap-

peared like purple petechiæ, and frequently terminated in offensive sores, discharging an ichorous serum. Mercury and other medicines were employed, but without effect; rather perhaps increasing the disorder. In the year 1792 these symptoms being urgent, Don Fernandez was recommended to try the Bath waters. In the letter which Dr. Scott wrote to the physician of the General Hospital at Bath, he observes, that he had tried bark, elixir of vitriol, hemlock, and that mercury had been rubbed in for three weeks, but without producing any effect on the mouth. He tried there the warm bath; and Dr. Ewart continued the mercury for two months, without its producing the smallest effect; and at length Dr. Ewart, declaring he "had used mercury enough to salivate a horse," advised him to return to London; when he became the patient of Dr. Donovan. It would be tedious to mention all the Doctors under whose care he has been, as Drs. Miers, Relph, Babbington, &c. &c. and many of different countries; and it is impossible to record their several modes of treatment. We shall therefore hasten to the year 1795, and mention the state in which he then was. The sores appear, 1794, to have healed up, by the application of tar ointment; but the muscles at this time were in a very hardened state, and assumed a very black appearance in both extremities. Under the skin there were many hard knots, and in similar points in the corresponding extremities; and these frequently broke into fetid and deep sores; whilst others dispersed without suppuration; and others again remained stationary. In the year 1795, the nose seems to have been first affected, and the ears, which appeared as if frost bitten, and mortifying off. At this time he was a patient of Dr. Sanderman's, and able to use exercise, notwithstanding the rigidity of the muscles. The disorder went on increasing, and he left Dr. Sanderman; and, in the year 1796, unfortunately fell into the hands of an Italian physician, who, with the most consummate folly, confined him to his bed for six months; ordered a large fire in the room, and no ventilation, and this in the heat of last summer; giving him, at the same time, his grand infallible specific for every disease, which he terms the *Phlogiston of the First Power*. He was at length so debilitated, that he was unable to sit upright in his bed. If he attempted to stand, his legs failed under him; and he had lost his appetite entirely, and hardly had power to speak.

Seeing him in this deplorable state, I mentioned to our Ambassador my wish of his trying the vital air under Dr. Thornton, and his Excellency obligingly complied with my desire. Don Fernandez in consequence inhaled the vital air, was ordered tonics, and such was the amendment, that in a week he was able to be removed from his bed to an airy situation in Chelsea. After his residence at Chelsea, and but three weeks, under this treatment, he was so invigorated, as to be able to walk to and from Duke-street, Grosvenor-square. In six weeks the muscles were evidently softened; there was a less

scaly eruption on the skin; and, at the end of two months, the unsound and sound parts of the nose and ears appeared united; and he is now so strong as to be able to walk from Chelsea to the Exchange, and back, without feeling the smallest fatigue; and his appetite and sleep are the same as if he had never been ill; and he is evidently much increased in bulk. The change produced is so striking, and the trials this patient had made are so numerous, and conducted by so many able physicians, that I cannot but contemplate this, as adding considerably to the reputation already so justly acquired by the pneumatic practice.

I am, dear Sir, &c.

CHARLES DE GIMBERNAT.

XXIV. ULCERS OF THE LEG.

CIRCUMSTANCES.

Case LIX.

The Rev. Mr. Atwood, under Dr. Thornton and Mr. Hill, cured. Vide Dr. Beddoes' Considerations, Part I. page 56.

Letter from Dr. Thornton to Dr. Beddoes.

Duke-street, Grosvenor-square, Feb. 27, 1795.

DEAR SIR,

I am very happy to hear your proposal for a pneumatic institution meets with the support of so many eminent physicians and men of science. I wait with the utmost impatience for its establishment, firmly believing that the experience resulting from it will be of the greatest public utility. The subjoined cases will be with you a great inducement for extending pneumatic remedies in the proposed institution to surgery; and they will, I trust, operate somewhat with the public in promoting a subscription sufficient for that benevolent purpose.

The first case will appear to great advantage, as the patient has obligingly permitted me to enclose to you his journal, which is the faithful picture of his own feelings; he assures me, he had not the least knowledge of any part of your theory of the operation of vital air, but was induced, from seeing a somewhat similar cure performed, to confide himself to myself and Mr. Hill, an ingenious surgeon, who has been among the first to apply these new powers to the purposes of his profession.

Journal of the Rev. Mr. Atwood, Rector of Saxlingham and Saxlingham.

Part I. Statement of the Case, and of the Effect of the common Means of Cure.

"December, 1779.—The left leg, for some time past, very heavy, is now much swelled, when pressure or induration continues. This was wholly removed in about nine

weeks by means of a very tight bandage on the leg, exercise, spirituous lotions, fumigations, and frictions.—October, 1780. The constitution much impaired by the hot climate of Spain; was attacked with jaundice, which yielded to slow journies on mules, and oranges.—January, 1785. Health was much deranged during this month, with great debility.—1786 and 1787. The habit much relaxed.—December, 1788. Had violent night sweats.—January, 1789. These continued to the latter end of this month.—May, 1789. Had a violent inflammatory fever.—August, 1790. Had an eruption on the surface on the body.—1791. During this whole year, experienced great debility.—March, 1792. Was seized with an inflammatory fever, attended with delirium.—May, 1792. Had a third attack. My physician ordered me sea-bathing, to remove the extreme debility which succeeded to this fever.—From August 1792, to February 1793, bathed in the sea. During this time I had many dreadful spasms in the stomach and bowels, accompanied with nausea and vomiting. These were the forerunners of the disease, which has since affected my left leg.—January, 1793. There appeared a mahogany coloured swelling in the left ancle of the left leg, which kept up an incessant gnawing pain.—July, 1793. This hardness was attempted to be eat away with caustic; but it produced only an ulcer of a very unfavourable aspect.—September, 1793. I placed myself under a most skillful surgeon at Norwich, who applied fomentation, unguents, &c. but without any material benefit.—November, 1793. Though a cripple, was enjoined regular exercise. The ulcer, however, still continued increasing. January, 1794. A new enemy more formidable than the other made its appearance. It had the same dark mahogany colour, and the same unconquerable hardness. By degrees this formed into a dreadful ulcer, which increased daily.—March, 1794.—Came to London, and placed myself under Mr. Cruikshank a surgeon of great eminence. Was attended by him daily with unremitting attention. Twice did he employ the lapis infernalis, but these ulcers seemed to resist every application. My constitution being extremely debilitated, with loss of appetite; want of sound sleep; and the mind exceedingly irritable, sea-bathing was once more enjoined.—From June 14, to October 18, bathed in the sea.—June 27. Mortification took place. The usual methods, bark in great quantities, port wine, and yeast poultices, were had recourse to.—October 25. Returned to London. The pains in the leg were excessive; the factor intolerable; the ulcers had made great encroachments; frequent nausea at the stomach; the bark and other medicines were fre-

short, every thing was unfavourable.—December, 1794. Had seen the whole progress of the case, asked my surgeon, "what prospect there was of saving the limb?" He made no reply, but very gravely shook his head.

The following letter is here introduced as essential to a complete idea of the case.

*To Dr. Thornton.**

Barnet, Feb. 25, 1795.

DEAR SIR,

Being accidentally present at the first interview between you, Mr. Hill, and Mr. Atwood, I cannot help expressing my great astonishment on finding so speedy a cure has been actually effected in so desperate a case.

The wound, I mean what particularly called my attention at the time, appeared to me to extend four inches in longitudinal direction of the muscles of the leg, and about three inches transversely. It was so deep that not only the whole thickness of the adipose membrane was destroyed, but a considerable loss of substance had taken place in the muscular parts themselves.

The ulcer was in appearance as ill-conditioned as I remember to have seen, either in the London hospital, or in my own practice of near thirty years, affording an ichorous foetid discharge, which appeared to inflame the surrounding parts, and which must therefore have gone on increasing the evil.

The gentleman's habit of body, from his own account, was such (for he had tried bark, sea-bathing, &c. without benefit) that I confess I had not the most distant idea that any cure could have been performed, much less in so short a space of time.

Indeed I think it a great happiness to mankind in general, that such a remedy as the vital air has been discovered, and that men of science are employing it: I am rejoiced to have such proof, that the blood and juices of our fellow-creatures can be so changed, that we need not now despair of our patients even in situations the most deplorable. I have the honor to be, &c. &c.

JOHN CORP.

Part II. of Mr. Atwood's Journal, beginning the Day before the Inhalation of Vital Air.

December 13. Got up with a peculiar sensation of weight and pain in the leg; a sense of nausea at the stomach; and no inclination for breakfast; spirits oppressed; and the mind irritable; when endeavouring to walk, felt great pain; the large ulcer in the leg looked of a blackish hue in some places; a probe being thrust into one part of the ulcer, I had not the least sensation in that part; yeast poultices were talked of; had no appetite for dinner; felt very much indisposed towards the evening; no inclination for supper; had a sense of chilliness on first getting into bed, succeeded by hot pains; passed as usual a bad night, with perturbed sleep; awoke at two o'clock with sharp and burning pains in the leg, which continued until five in the morn-

ing; dosed till nine.—December 14. Got up with nausea at the stomach; and a sense of languor; no appetite for breakfast; spirits exceedingly oppressed; for the first time inhaled the vital air diluted with a portion of atmospheric; had a pleasurable glow at the time; felt an appetite for dinner, and my friends observed my cheeks did not flush after dinner, as heretofore; my spirits, which were somewhat better during the day, sunk towards the evening; no inclination for supper; passed a very indifferent night.—December 15. Got up, but without a sense of nausea; had a slight inclination for breakfast; perfect ease in the leg; inhaled again the vital air; felt a great appetite for dinner, and a peculiar pleasurable lightness after dinner, as if no sustenance had been thrown in; with a flow of spirits; and a strange idea of being able to mount a horse, and ride as fast as people in health; appetite for supper; passed the sweetest night! such as I am sure I have not enjoyed these four years.—December 16. Got up quite refreshed, without the least sense of nausea at the stomach; a great inclination for breakfast; spirits unusually elated; took the vital air; felt a genial glow during the whole day; great appetite for dinner; walked with agility and without pain; the wound however appeared unfavourable to-day; appetite for supper; a good night; awoke with a thick clammy perspiration.—December 17. Spirits much depressed; no inclination for breakfast; mind very irritable; much pain in the wound; inhaled the vital air; the wound threw off nine sloughs this day; a slight appetite for dinner; the spirits recovered towards the evening; inclination for supper; had a sound night's rest.—December 18. Appetite for breakfast! inhaled the vital air; a sense of glow, which extended even to the fingers' ends; the muscular powers were evidently increased; walked with slight, or no pain.—December 19. The wound for the first time discharged real pus; had the sensation, if the expression can be allowed, of perfect health, never experienced before this week; sleep very sound; pains in the leg towards morning.—Dec. 20. Got up with great spirits; inhaled the vital air; the wound discharged a great quantity of real pus; a craving for dinner; felt no longer an inclination for much wine, and after four glasses, had the same satisfaction, as three pints used formerly to produce; porter was now rather coveted; spirits elevated in an extraordinary degree, which, together with a genial summer's warmth, continued from four to nine in the evening, and then subsided to humble spirits; slept profoundly from ten to four, which, with the morning doze, made me get up sufficiently refreshed; transitory pains in the leg.—December 21. A fine appearance of white edges in the wounds; great appetite for dinner; an universal glow in bed, accompanied with perspiration; sharp twitching in the leg.—December 22. Appetite for breakfast; inhaled the vital air; the wound still kept on a great discharge of laudable pus; no appetite for dinner; in the evening a peculiar sense of weight and uneasiness

in the leg; a great listlessness in the evening; much irritation in the leg, particularly in the ulcer, with much itching round the part; but an indifferent night.—December 23. Spirits oppressed; inhaled the vital air; returned home without much inclination for dinner; spirits rather mended towards evening; enjoyed a good night's rest.—December 24. Eat a hearty breakfast; spirits elevated; walked with ease and vigour; a surprising change for the better had evidently taken place in the wound; appetite for dinner; had a good night.—Christmas day. Still the same happy appearance in the wound to-day.—December 27. The ulcer looked wonderfully well; was evidently decreased in size; the discharge very favourable; but less in quantity; great pain was felt in the ulcer for a quarter of an hour in bed; afterwards fell into a refreshing sleep.—December 28. All the appearance of healing; the wound much decreased; some parts filled up; and the borders of a fine white; the whole leg, which before exhibited a dark purplish appearance, wore now the livery of health.—December 29. The cavity of the wound was almost filled up; the effects of the vital air operating together with my amendment, produced a constant gaiety, as if I had been drinking champaign; enjoyed a profound night's rest.—December 30 and 31. The same sensation of perfect health; elevated spirits; great appetite; and comfortable sleep.—New-year's day. Every thing in a good train. My toast after dinner was, "May Dr. Beddoes and Dr. Thornton the introducers of aerial remedies meet with that recompence from their country, which they so amply deserve."

[This toast from motives of delicacy I would have omitted, but I thought it my duty to transmit you the journal entire as written by the author. R. J. T.]

"It was applauded and unanimously drank.—Jan. 1, 2, 3, 4, 5, 6, 7. As on the preceding days, with evident and progressive amendment in the wound.—January 8. Went to a private concert; before, music was disgusting to me, having no spirits to enjoy it; was surprized to find myself standing, as I was playing on my violin, without leaning on a chair, at several different times during the evening, and without the least sensation of fatigue or pain.—January 9. The smaller ulcer, which of late I have not much noticed, was healed.—January 10, 11, 12. Nothing peculiar.—January 13. The old ulcer was this day rubbed hard with a flannel, and the larger ulcer appeared nearly healed.—January 14. Walked with great vigour; the larger ulcer was rapidly skinning over; appetite good; spirits good; and sleep the same.—January 17. Notwithstanding the season, the most inclement I remember, the ulcer was completely skinned over: and my body seemed fortified against cold."

Here ends the journal. I have to add that on the 25th of February, the family received a letter from Mr. Atwood, from on board the *Stately*, of which ship he was made chaplain. He was then in perfect health and spirits.

Letter

Letter from Mr. Atwood to Dr. Thornton.

Symon's Town, Cape of Good Hope, 15th Sept. 1795.

MY DEAR SIR,

I ardently wish to enjoy the happiness of seeing you again. You have performed wonders on my peculiar constitution, formerly strong and powerful, but which was hastening to a rapid dissolution, till revived and renovated by the oxygen air. My strength is encreasing every day with a firmness of nerve and calmness of spirits never experienced before. I persevere in an uniform plan of rising at six, walking till eight, subsisting on soup, fish, and vegetables, and going to bed at ten. Wine is left off (except three glasses of white Teneriffe wine at dinner), as well as meat. By these means I feel the habit cool and braced; with a capability of taking powerful exercise, without the least fatigue. The fleecy hosiery waistcoats you recommended are absolutely necessary in this climate, as heavy dews and cold winds at sun-set often succeed the heat of the day. The prevailing disorders of course are fevers, flux, and dysentery, which destroy many patients; except this sudden check to perspiration, the climate is delicious, but in my opinion not so hot as at Lisbon. Last June (December here), green peas were in blossom.

With the greatest esteem,

I remain, ever gratefully yours,

T. E. ATWOOD.

ULCER OF THE LEG.

CIRCUMSTANCES.

Case LX.

Communicated by Dr. Thornton.

John Patterson, under Dr. Thornton and Mr. Hill, cured. Vide Dr. Beddoes' Considerations, Part I. page 65.

John Patterson, aged 45, married; has five children; he was formerly a sailor. He had endured much hardship, and at one time lived for nine months wholly on salt provisions. He was subject from the age of fourteen to eruptions on his face. When he came under Mr. Hill's care, I saw him, with a face encrusted over with humours, several purple blotches on his body; many hard scales or scurfs about his arms, and a dark-coloured deep ulcer in his leg, which gave out an ichorous and fetid discharge. He had also lost his sight near eighteen months. These complicated evils had resisted the well-known abilities of Messrs. West, Carr, Turnbull, Wathen, Phipps, and others. This case being recommended to Mr. Hill by the last named gentleman, he gave him the vital air blended with atmospheric air, as an alterative of the blood, strengthening his constitution with chamomile tea and bark, and Mr. Phipps continued those applications to the eyes, which, before the purification of the blood,

proved unsuccessful. After a few weeks' inhalation of the modified atmosphere, I had the satisfaction of seeing him with a face perfectly clear and smooth; large white scales fell from his hands and arms; the dark purple ulcers on his body, and the varicose ulcers in his leg, were healed; and he had so far recovered his sight, that he had at first a blue, then a brighter light before him, and after a regular attendance during four months, he was able to discriminate different objects in the street.

Letter from the Rev. Mr. Townsend to Dr. Beddoes, relative to the two last Cases.

Pewsey, July 21, 1795

DEAR SIR,

When I was in town, Dec. 15, I called on Dr. Thornton, and finding him engaged with patients, I went into the parlour, where I met with Mr. Atwood. We soon entered into conversation, when he communicated his apprehensions of losing his leg, and asked me if I believed that the vital air could effect any thing in such a case. Finding this gentleman desirous of having my opinion, I explained to him, that though spirituous and other stimulating local applications might call forth, for a time, the action of a part, in which the vital energy was much diminished; yet, as exhausting it without producing action sufficient for a cure, a proportionable debility and tendency to gangrene must ensue. This, Sir, said he, is exactly my case. After every application, exciting pain, black parts have constantly appeared, which were either taken away by the knife, or else sloughed off. It is so, said I, with spontaneous mortification: it is preceded, in weak habits, by inflammation accompanied by a proportionate loss of power. But when the air is rendered by the chemist more replete with that substance, which is essential to vitality, and is inhaled by the lungs, this alters the disposition of the system, and produces what has been called the phlogistic diathesis, whereby the exhalant arteries pour forth instead of serum, coagulable lymph: the absorbents carry away diseased parts; and the lymph being rendered more tenacious, is converted into granulations. In the new mode of treatment with vital air, energetic action in the part is supported by the system: in the old practice it is kept up for a short time only, by partial stimuli on weak and diseased vessels. There it is produced with a change of the blood; here it deprives the blood of life: there it produces energy; here it excites irritation: there it aids the efforts of nature, and renders them effectual; here it calls her into action, which she is unable to support. This reasoning seemed to have weight with him, and now our conversation was interrupted by a message from Mr. Hill, that he was ready to attend his patient. However, I begged permission of Mr. Atwood to see his wounds, which emitted a very offensive factor.

and had discoloured his stocking. But no sooner were the applications taken off, than the fœtor became intolerable, and the sight so disgusting, that I was constrained to hasten into the open air. On my return to London, Jan. 15, I was impatient to know what had been the issue, and gave Mr. Atwood the meeting as before. The lesser of the wounds was healed, and bore the friction of a brush. The larger wound, so well described by Mr. Corp, (Second Edition of Considerations, Part II. page 55) was filled and covered with skin, excepting one place the size of my nail, which he told me was occasioned by some accident.

I was equally pleased this day with having a sight of Patterson, whose case is so well described by Dr. Thornton (Consid. Part II. page 57). His leg, now healed, shewed what had been the extent of his former ulcers which were not fewer than fourteen or fifteen; his face was clear, and when I put a little bit of paper on the ground, he saw well enough to go and pick it up.

I am, Sir, &c.

JOS. TOWNSEND.

ULCER OF THE LEG.

CIRCUMSTANCES.

Case LXI.

Mrs. Munt, under Dr. Thornton and Mr. Hill, cured. Vide Dr. Beddoes' Considerations, Part I. page 66.

Communicated by Dr. Thornton.

The subject of the next case is a widow lady. She had a humour in her right leg, which deprived her of exercise; and had produced a painful and discoloured sore in that part of above 18 years' standing; four years of which time she was attended by Pott, and twenty-seven months by Sharp; but neither of these eminent surgeons were able to effect a cure. After only three weeks' inhalation of the vital air, a violent itching came on, and in another week this leg was rendered as sound as the other. Mr. Sharp saw this patient at Mr. Hill's, and examined her leg, and was very much delighted. This lady has now continued well near six months.

Letter from Mrs. Munt to Dr. Beddoes.

Store-street, Sept. 1, 1795.

SIR,

I was about eighteen years distressed with a dreadful humour covering the whole of the lower part of the left leg. It arose from water first in that part, and a tendency to the dropsy. I was four years under Surgeon Pott, twenty-seven months under Sharp, nine months under Blick, twenty-seven months under Wade, and for some time under other eminent surgeons, but the humour continued as before. Previous to my attendance on Dr. Thornton and Mr. Hill, I was very bad indeed, in great pain

and not able to walk fifty yards. After a fortnight from inhaling the vital air, I felt a most intolerable itching in the leg, and soon after the humour scurled away, and the leg was healed. It is now eleven months since my cure, and I have felt no pain whatever, nor has even a pimple appeared on the part; and as before I could not walk an hundred yards, now nothing impedes my walking but my corpulency, which probably arose from my former long confinement.

I am, Sir, &c.

ELIZ. MUNT.

Observations on this Case by Dr. Thornton.

1. In fat people I have observed that super-oxygenated air usually creates some disturbance in the stomach. This at first surprised me; but did not the super-oxygenated blood feed upon the elements of fat, and thereby prevent the supply of food from the stomach, and that organ being robbed in some measure of its office, might it not at first feel the want of its customary action?

2. Fat people, I observe, are longer in consuming a given portion of air than others; hence perhaps they become liable to diseases, dependent on, or accompanied with, a want of oxygen in the blood.

3. In the present case strong occasional evacuations were employed. In the intervals, bark with the tincture of the same, and myrrh, were given to strengthen the fibres and promote the consent which exists betwixt the stomach and the lungs.

4. The average dose of air employed, was thirty quarts of atmospheric air, super-oxygenated with two and sometimes three quarts of vital air.

UICER OF THE LEG.	CIRCUMSTANCES.
<p>Case LXII. Mrs. Wilkinson, under Dr. Thornton, cured. Vide Dr. Reddick's Con- siderations, Part IV. page 139.</p> <p>colour of mahogany. A great variety of remedies had been tried, as water-dock, elm bark, sulphur, &c. and this lady, by the advice of Dr. Haighton, physician to the Eastern Dispensary, had taken for the last four months bark and lime water. As Dr. Haighton thought her disease depended wholly upon the</p>	<p><i>Communicated by Dr. Thornton.</i></p> <p>Mrs. Wilkinson, who lives in Dartmouth-street, Westminster, had for fourteen years a scorbutic humour in the legs, con- solidating into sore the muscular parts, which scurled, and occasioned frequent and violent pain, and an almost incapacity for exercise. The muscles of the calf were hard, and of the</p>

constitution, and there was no need of any local application different from what Mrs. Wilkinson was in the daily habit of applying, I was happy to add upon this occasion the vital air. This lady, after inhaling a week, felt violent itching and pain in the legs; the colour of the parts was visibly improved; and the ulcers exhibited marks of active inflammation. In a few days after this, the wounds, which were ten in number, instead of a thin acrid discharge, threw out pus, and the edges were diminished. The hardened muscles not long after became soft. The other beneficial effects of the vital air, as far as regards appetite, spirits, warmth, sleep, &c. were the same as those which are so energetically described by the Rev. Mr. Atwood, in his invaluable Journal. In six weeks only Mrs. Wilkinson could use the flesh brush to both legs; and the last account I have of this lady is, that she was able to walk from Ramsgate to Margate, five miles, without a sensible pain in the legs, or even fatigue. I shall hope to send, at some future time, the sequel of this interesting case; and shall beg leave now to observe, that the leg of Patterson, which had for two years fifteen or twenty holes in it, which were healed by the inhalation of a super-oxygenated air, has continued perfectly sound, it is now above eighteen months; which leads me to the hope, that a permanent benefit will be also derived to the lady.

R. J. THORNTON.

Letter from Mr. Wilkinson to Dr. Thornton.

Darlington-street, Sept. 7, 1797.

DEAR SIR,

Although you have never once asked my opinion respecting the effect your air has had on my wife, I think it but justice publicly to declare, that during the course of fourteen years my wife has never enjoyed such a state of health as since she has inhaled the facitious air. She has in that course of time applied to several medical men of great ability, but without any good effect. She had not inhaled the air more than three times, before I perceived a very visible difference in her countenance, in her spirits, in her appetite. The ulcers in her leg gradually dried up, and have never appeared since; it is now a twelvemonth. She is now ten years younger, at least, in constitution. In short, whatever Prejudice may say, I am sure, that under God, the oxygen air has been the sole means of her recovery; and that there is not any one thing in nature besides that the cure can possibly be attributed to. I most sincerely thank you, Sir, for your kind attention to her, and I do sincerely believe if mankind at large were as sensible of the good effects of the air as I am, when properly and judiciously administered, you would need a host of agents to assist you in this grand and benevolent undertaking.

I am, dear Sir,

Wishing you every success your merits deserve,

Very sincerely your's,

J. WILKINSON.

Case LXIII.

Mr. M'Kennon,
under Dr. Thornton,
cured. Vide
Philosophical Ma-
gazine, Number
XIX. page 291.

Communicated by Dr. Thornton.

Mr. Roderick M'Kennon, aged 67, went in the year 1758 as Assistant Apothecary to St. George's Hospital, where he had his washing, board and lodging found him, with a suitable salary. In June, 1795, whilst in this employ, he went to see Dr. M'Nab, then resided in Great Suffolk-street; and as he was at the door, a bitch in the house, who had puppies, furiously flew at him, and seized him near the calf of the leg, making a deep lacerated wound. The wound soon after became dreadfully inflamed, poultices were applied, but it was near a fortnight before he made his case known to the surgeons of the hospital. He was now confined to his room, and Mr. Home a most experienced and eminent practitioner continued his humane attentions to him above a twelve month, trying a variety of different applications, until, finding his case hopeless in his endeavours, he was dismissed from his employ, and left the hospital incurable. Added to this dreadful and unforeseen affliction, he had an asthma, which had existed on him above ten years, was obliged him frequently to sit up the greatest part of the night with the windows wide open to procure breath. He was now in the vale of years, and with a gloomy prospect before him, for no salary was allowed this almost superannuated servant of a public charity, to which he had been attached above thirty years; and he had a wife and daughter to provide for. After quitting the hospital, Mr. Carpie, a surgeon, no less distinguished for zeal than abilities, for some months attended him; but finding all his endeavours ineffectual, he reluctantly took his leave of him as incurable. Such was the deplorable state of this unfortunate sufferer, when Mr. Carpie recommended him for trial with the oxygen air, using these very expressions: "Poor Roderick has been under Mr. Home's care" (an eminent surgeon, brother-in-law to John Hunter), "in St. George's Hospital, which he left as incurable, and since under my care for several months; and so bad is his case, that I am sure if you can cure him, you can cure the devil." Being no surgeon, I could have no wish to accept of such a case but for the cause of humanity and the sake of science; and I feel extreme delight in saying, that poor Roderick is now perfectly cured, the ulcer is healed, his asthma gone; and, in order that the philosophic world may see fuller particulars respecting this extraordinary cure, I am happy to be able to add the following testimonies:

A letter to Dr. Thornton from Mr. Carpue, Surgeon at the York-Hospital.

DEAR SIR,

I have seen Mr. McKennon, and have examined his leg, and think the cure you have wrought on it is indeed very astonishing. When he first came under my care, he laboured under an immense ulceration, extending from the external angle of the right leg, which reached as high as the junction of the tendons of the gastrocnemii and solæus muscles. At this period the tendons of the peronæal muscles had sluffed, and in consequence I applied charcoal, which produced very considerable good; but upon mentioning this to a friend, who knew the case well*, he said, "It was immaterial what remedy I used, for it was a case in which he was certain nothing would prove effectual." After I applied the diluted nitrous acid, and seemingly with advantage; but being obliged to go into the country, I left him under the care of another surgeon; and when I saw him, after an absence of six weeks, I found the sore in a very unfavourable situation, and for four months I used different applications, but without success, and I conceived the case now to be perfectly incurable, and I mentioned it to you when I had the pleasure of seeing you at Mr. Heaviside's; and I then proposed him to the trial of the oxygen air, as his case, I succeeded, and I prove most decidedly its efficacy; for, in the multitude of legs I have attended, I must acknowledge I never saw a case so old West-India sore excepted.

I have the honor to be, Sir,

Your obedient servant,

J. C. CARPUE

Having referred Mr. McKennon to Mr. Spencer, a surgeon in Charlotte-street, Fitzroy-square, who administers the pneumatic remedies, I received the following letter:

A letter to Dr. Thornton from Mr. Spencer.

SIR,

I herewith enclose the treatment and the progressive cure of the ulcer which occupied the external angle of the right leg of Mr. McKennon. For six weeks, by your direction, he daily took a gallon of oxygen air, mixed with four times that quantity of atmospheric air. The ulcer discharged properly, but seemed to heal very slowly: in consequence I gave him a double dose, and after a fortnight it produced very feverish symptoms, when he took, by your order, some purgatives, and then he resumed his usual dose of superoxygenated air daily, until the ulcer di-

* Dr. Bailey, physician to St. George's Hospital.

minishing by degrees, was at last completely healed, there being no discharge, the whole cicatrising, and the new-formed surface looking extremely healthy. During this period no particular application or dressings were made use of by me, nor any medicine directed by you, but what before he said he had taken gallons of; so that I attribute his extraordinary cure entirely to the efficacy of the oxygen air. Happy in being able to give my testimony to so remarkable a case, I have the honor to be, dear Sir,

With the profoundest respect,

Your obedient humble servant,

T. SPENCER.

Remarks by Dr. Thornton.

As Mr. McKennon took bark, some of the faculty may not be willing to give to the oxygen air the merit in this cure; I will therefore endeavour to state shortly my reasons for attributing every thing to this new remedy.

1. The operation of bark had been before tried; he had taken, he said, gallons of it.

2. When I first saw him, the sore, and muscles surrounding it, were wholly insensible; he did not feel a needle piercing them, nor could he perceive even the corrosive operation of caustic.

3. After inhaling the vital air but a few days, sensibility was restored, as Mr. Carpue and others witnessed.

4. Having cleansed the wound, it would remain dry for hours; but even whilst inhaling the vital air, the whole surface was immediately covered with a fine dew, as Dr. Monro and others witnessed.

5. To shew the progress of amendment whilst inhaling the superoxygenated air, I am happy to be able to lay before the philosophic world the following testimony of an impartial observer, Mr. Douglas, of Baliol-College, Oxford:

"Towards the middle of March, 1798, I first saw Mr. McKennon. He had then a large and very foul ulcer, extending some inches above the right ankle. From that time to the present (April 30) I have repeatedly seen him, and each time could not possibly fail to be sensible of a most manifest improvement. At present the ulcer is diminished at least one-half its size since I first saw him; the edges have a fine healthy appearance, and its general surface is astonishingly altered for the better."

6. When the oxygen air was left off, the sore remained stationary, and visibly improved when he again resumed it.

7. My strongest argument, however, is the success in this and in other cases equally desperate.

Mrs. Munt had been before cured of a sore leg of eighteen years' standing.

Mr. Atwood was cured of a sore leg of two years. When I asked Mr. Cruikshank whether it was true he had condemned the leg? he answered, with his usual emphasis, "I not only condemned his leg, but his life; for he was of so washy a constitution that he could not have lost the one without the other."

Next, the cure of Patterson. When I sent him to shew his leg to Mr. Cruikshank, which still possesses the marks of numerous ulcers, seeing varicose veins, this experienced surgeon said: "Tell Dr. Thornton that he is mistaken if he supposes he has made a permanent cure; for varicose ulcers were never cured without an operation, which, if he wishes, I will perform." The man, frightened at first, and then astonished, replied: "Sir, I have been cured perfectly now these two years." "That alters the case," answers this distinguished anatomist; "then tell Dr. Thornton that he has performed a most remarkable cure." Patterson still continues well; nor does there seem the smallest cause to suspect a relapse.

The cure of Mrs. Wilkinson, who had a sore leg fourteen years, is not less extraordinary. In this case I observed a peculiar phenomenon, alone explicable by the operation of the oxygen air. The fingers of both hands at their ends looked very red, as red as raw meat, were swollen, and felt very painful. The same was mentioned to me in private conversation by Dr. Beddoes in a patient of his, who, finding an asthma relieved by a small dose of vital air, took as much as he could at one time, produced a fever, and this same phenomenon I have just mentioned above.

This leads me to repeat an observation I have again to express, that oxygen air promises to be an useful remedy in sore legs; for why have we not sore arms? The nearness of this part to the heart seems to be the only philosophic reason; and therefore a direct powerful stimulus to the heart, as oxygen air, promises the most certain good, aided by the invigorating effects of bark, steel, and other tonic medicines*; not but that I would advise, where it can be properly done, as in hospitals, trials to be made with the vital air without medicine, to prevent all cavil; although it is undoubtedly unimportant to the sufferer by what means he is treated, so that he is but cured; and, until the contrary is proved, I shall ever think, that medicines, judiciously employed, certainly cannot impede the operation of oxygen, but may assist it.

* Vide general observations at page 543, and note * page 545, of this volume.

XXV. MORTIFICATION OF THE HEEL.

CIRCUMSTANCES.

Case LXIV.

Mrs. Frith, under Dr. Thornton, cured. Vide Philosophical Magazine, No. X. page 213.

Communicated by Dr. Thornton.

Mrs. Frith, æt. 45, wife of the Rev. William Frith, rector of Kentish Town, for nearly four years experienced the most violent pain in the neighbourhood of the heel, which she could compare to nothing but the burning of a caustic. Various outward applications had been made, and medicines taken internally, without any alleviation. When Mr. Cruikshank, lecturer on anatomy in the school of Dr. Hunter, called me into consultation, there was extended over the heel a wound about the size of a crown, very dark, the edges livid; and the fætor from it was so intolerable that, when her maid had occasion to remove the dressings, she had always volatiles applied to the nostrils to prevent her from fainting. The countenance shewed a livid paleness, the pulse was quick and tremulous, and the slightest exertion produced faintings. The bark, opium, and wine, were continued. This lady inhaled also six quarts of vital air mixed with twelve of atmospheric, and in a few days, as this respectable family can also testify, the livid hue of the wound disappeared, it had a more healthy appearance, and the discharge was so greatly improved, and fætor gone, that when the smelling-bottle was presented to the servant, she said that there was not the least occasion for it. In a fortnight the sore was completely healed, the appetite restored, and countenance so greatly improved, that every friend marked the sudden alteration; the violence of the internal pain lessened by degrees, and the superoxygenated air being continued for a few weeks longer, it altogether subsided; and this lady, for these last six months, has enjoyed uninterrupted health, and is able, at pleasure, to walk up Highgate-hill.

As many persons might wish to see the lady's journal in her own words, I here subjoin it, with a few observations.

"September 13, 1798. First inhaled the vital air. Felt acute spasms in the chest, and fainted."

Observation. Artificial inhalation is accompanied with increased action of the intercostal muscles, and gives frequently afterwards a sensation of muscular pain, which speedily goes off, and after a few trials does not appear again. The second effect we always see in those very weak, and hence the expression of "*being overpowered by the air.*" Patients labouring under scurvy, if suddenly exposed to a clear air, are killed instantaneously.

"September 15. Felt a most pleasant glow after the inhalation of the vital air. Spirits also much increased, feeling as if a great weight, or oppression, was removed.

" September 16. The hardness about the heel gone, as also the fætor. Has less discharge. The wound looks redder. The glow, after the inhalation of the vital air, lasts for about a quarter of an hour.

" September 18. The glow, and spirits, after the last inhalation, lasted four hours. Feel wonderfully light and pleasant.

" September 20. Asked by my apothecary, " Whether I did not feel, from the inhalation of the vital air, an uncomfortable heat?" My answer was, " that it produced the most pleasant glow imaginable, not at all resembling heat."

Observation. Putting the thermometer under my tongue, the heat was not increased. This effect may, perhaps, be accounted for from the increased sensibility of the nerves; or does the insensible perspiration raised by the capillaries of the skin being filled by the greater energy of the heart, account for this phenomenon better? I have almost invariably found the inside of the palm of the hand, after and during the inhalation, break out in a pleasant moisture, which are parts somewhat remote from the heart.

" October 4. The pain in the heel infinitely more lively. The pain is a new pain; but, thanks be to God! it remits for three or four hours every day."

These are the chief particulars: the plan of your Magazine may not admit of a further detail, nor does the nature of the case seem to require it.

General observation. The change of colour in the wound, so immediately after the inhalation of the vital air, seems to indicate a remarkable change wrought in the blood. It is not, however, the temporary increase of oxygen only in the system, that this partial inhalation produces; for it renders the blood also more attractive of this principle. Hence the continuance, for some time, even in London, among people of fashion, of the good looks acquired in the country; hence the pallid countenance of the man lately recovered from suffocation, or drowning; and hence, also, the return of the breath in patients under this treatment being more and more noxious, from a greater absorption of oxygen. The deterioration of the air inspired, has ever indicated the attractive power of the blood. Hence, also, it is that substances abounding in hydrogen are called cordials, from their sympathetic action on the heart, through the medium of the blood; but in the superoxygenated air we have a more direct action on the heart, without exhausting the irritable principle, and occasioning indirect debility; and I trust I shall be able to make it evident to the unprejudiced mind, that this is a great desideratum in surgery and medicine, more especially where diseases are remote from the heart; or else, why do we so frequently hear of sore legs, but never of sore arms?

XXVI. ATONIC GOUT.

	CIRCUMSTANCES
<p>Case LXV. Augustus Ernest, under Dr Thornton, cured. Vide Number XXI. of the Philosophical Ma- gazine.</p>	<p><i>Communicated by Dr. Loane.</i> Augustus Ernest, Esq. in the beginning of August, 1799, was seized with symptoms of asthma, great wheezing, and difficulty of breathing, cough, mucous expectoration, and incapacity of lying in an horizontal posture. Hence arose much œdema of the lower extremities. Different medicines were tried without effect, when Lord Egremont urged him to make trial of the oxygen air under Dr. Thornton, September 20. This remedy was accordingly had recourse to, and after inhaling the vital air but a few days, so much benefit was derived, that the patient was enabled to lie composed in bed during the whole of the night, and after a fortnight so great was the energy produced, that the gout made its appearance in the great toe of the left leg. The asthma, from this period, quitted Mr. Ernest, and the inflammation continued for the space of ten days in the toe and parts adjacent, and the subsequent swelling gradually subsiding, the patient was restored to perfect health. He then went to Lord Egremont's, previous to which I received the following satisfactory letter.</p>

Letter to Dr. Loane.

November 9, 1799.
Warwick street, Golden-square, No 7.

DEAR SIR,

I am just going into Sussex to breathe there some of the pure atmospherical air; but I cannot leave this metropolis without reiterating to you and Dr. Thornton, with the tenderest expressions of gratitude, the warmest acknowledgments for the benefit you have conferred on me, by administering to me the vital air; indeed, when I compare the situation in which I was, at the end of September, when I, as a dying man, came under both your cares, to what, thank God, you have brought me now; it seems to me quite miraculous, and I shall always look with astonishment at the wonderful discovery which has been made of the salutary virtues of the oxygen air.

I am, with sincere regard,

Ever faithfully your's,

AUGUSTUS ERNEST.

When Mr. Ernest returned to London, his friends, Lord Anson, Count Bruhl, &c. congratulated him on his recovery, but his

asthma soon after made him a second visit, and the vital air was again resumed, when in a few days it brought about another attack of gout in both feet, which went off kindly, leaving the patient in excellent health and extraordinary spirits.

It may be proper to mention the average dose of vital air daily given was six quarts, mixed with twelve of atmospheric air, and this was conjoined with the medicines most commonly given in such cases.

Several other interesting cases will be found in the body of our Work, in which *vital air* was administered, chiefly with the intent of counteracting the evil of vegetable and animal poisons, and we trust enough has been already done to invite other labourers into the vineyard; and happy shall we think ourselves if our endeavours have at all conduced to that end.

As the Reader advances in this Work, he will see the system upon which the conduct of the *pneumatic* practitioner was conducted, and perhaps may be induced with him to think, that multiplying the tonic actions in asthenic diseases by as great variety of means as possible*, is the most philosophical mode of practice; and the facts adduced are a sufficient evidence of its utility.

We come now to the consideration of the application of *azotic air*, which has been given to moderate the too great action of the system, or take off local inflammation.

* Vide especially Vol. II. Note * page 502, where this principle is enforced, and it explains how the *aerial remedy* becomes applicable in such a number of diseases. In the practice represented here, the stomach is braced and strengthened by bark, myrrh, steel, and zinc; the blood improved, and hence the whole vascular system, by the inhalation of *vital air*, the mind is likewise exalted with the hopes and novelty of this mode of living enforced; and thus every energy is called forth. But the public mind has been long affected by the doctrines of *specifics*, and as, "what is good for every one is good for nothing," for QUACKERY advertizes the same *specifics* for every disease, so no credit will be given by many to the healing powers of the constitution, and less to those means which act on the *Constitution*, and thus on a variety of diseases of the same class, but in the issue, "*truth and science will prevail*:" and as constitutions are differently affected by the same means, hence the necessity of discrimination in the practitioner, and hence our prophecy, that the extinction of Quackery is at no great distance in an enlightened age. Steering is very simple, move the rudder ever so little to the right or left, and the ship turns in a contrary direction, put it straight, and the ship moves straight, but God has so connected mankind, that even the conduct of this simple process requires so much intelligence, and it will be found to be the same with engraving, writing, tuning of instruments, hair-dressing, and physio-

CASES WHERE AZOTIC AIR HAS BEEN EMPLOYED.

XXVII THE CROUP.

	CIRCUMSTANCES
<p>Case LXVI. Mary Tovey, under Dr. Thornton, cured. Vide Mr. Townsend's Guide, Vol I. page 103.</p>	<p>Mrs Tovey, of Charles-street, Tottenham-court Road, having lost one child in this sonorous and terrific disorder, anxiously brought her only remaining boy to Dr. Thornton for his advice. He immediately made the child inhale the azotic air with a proportion of common air, and the father and mother were surprised, when they observed that the hands, which were before "parching hot," soon felt "cold" to the touch; the pulse was rendered 20 beats less in a minute; the child no longer coughed as through a brazen trumpet, the fever seemed smothered, and the formation of the fatal membrane was prevented.</p>

Six parts of azotic air were inhaled, made by gradually burning of spirits of wine under a bell-glass

XXVIII. PNEUMONIA.

	CIRCUMSTANCES
<p>Case LXVII. Mr Crump, under Dr. Beddoes, cured Vide Beddoes' Considerations, Part I. page 175.</p>	<p><i>Communicated by Dr. Beddoes.</i> In the inflammatory stage of catarrh, and all the gradations of disease which connect a common cold with pleurisy, I hope the exhibition of a lowered atmosphere will prove an effectual remedy. From several cases I am at present inclined to prefer hydrogen or azotic air, because they can be so freely and frequently administered. In my letter to Dr. Darwin, I have described the effect of atmospheric air lowered with one-eighth of hydrogen air, and respired for a quarter of an hour, in an inflammation of the chest. The acute pain entirely subsided while the patient was breathing this mixture, and the febrile symptoms disappeared.—I have been eye-witness of another fact of the same kind, since.</p>

XXIX. PHTHISIS.

CIRCUMSTANCES

Case LXVIII.
Lieut. — under
Dr. Beddoes', cured.
Vide Dr. Beddoes'
Considerations,
Part IV. page 111.

Letter from Mr. Scott to Dr. Beddoes.

Bombay, May 4, 1796.

SIR,

I have lately met with a case which is a confirmation of your opinion regarding the phthisis pulmonalis, and its method of cure. A lieutenant in the Bombay marine was lately, at Bengal, so ill of a complaint which every body believed to be a consumption, that for a long time he was incapable of doing his duty, and given over as incurable. In this hopeless situation it became necessary to him to proceed to Bombay. During the passage the bilge water of the ship got at some sugar with which she was laden; which, from its decomposition, was supposed to have injured very much the purity of the air. Below decks the air certainly became very impure; which at first induced this gentleman to remain above: but he one day, on going down below, observed that his respiration went on much more easily than on deck. He soon fell into a sound sleep in this new situation; and from that time he remained below in this atmosphere, from which he continued to feel relief. His health afterwards daily improved; and he is at this moment in good health, and doing his duty at sea.

I remain, Sir, &c.

W. SCOTT.

CIRCUMSTANCES.

Case LXIX.
Mr. Gregory, under
Dr. Thornton,
cured. Vide Phi-
losophical Maga-
zine, Number XIII.
page 95.

Communicated by Dr. Thornton.

Mr. Gregory, M. P. of Berner's-street, who had been long resident in India, laboured for several months under all the symptoms of phthisis pulmonalis. He expectorated a quantity of thick, opaque, and yellowish matter which sunk in water, had disturbed nights, was greatly wasted, and his breathing was short and interrupted. He took by my order (which was executed by Mr. Seaton, a very ingenious apothecary and able chemist, who lives in Bridge-street, Westminster) from four to six quarts of hydro-azot daily, mixed with twelve of atmospheric air, and at the same time had a mixture of myrrh and bark, with opiates occasionally; and under this treatment the cough was soon diminished, and in six weeks the patient was restored to health, and has continued free from every complaint these eight months; even a cold now produces no exciting any symptoms of alarm.

Observations by Dr. Thornton.

The hydro-azot is made by burning æther under a tin bell, when the oxygen unites with the hydrogen and forms water, and the residue is azotic air; a species of heavy, inflammable, or hydrogen air, and some æther in the state of vapour, and a small proportion of fixed air. I have myself inhaled ten quarts of this pure, and the pulse has sunk from eighty to seventy beats in a minute, and continued so for a quarter of an hour or more. It is very grateful to the lungs; and I flatter myself, that this new species of air, first employed by me, may prove hereafter a valuable acquisition to the *ars medendi*. As we brace the constitution with tonic medicines, there is danger of local inflammation, which this appears to obviate; or, has the hydro-azot any peculiar healing quality?

The reader is referred to Dr. Beddoes' Considerations, where great many cases are related, in which the hydrogen, hydro-carbonat, and other mephitic airs and vapours have been employed in pulmonary diseases, &c. but it is from the establishment of the *Pneumatic Institution*, which we have before announced, that we expect the full crop of discoveries in this interesting a branch of science.

END OF VOL. I.

